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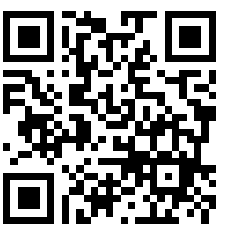

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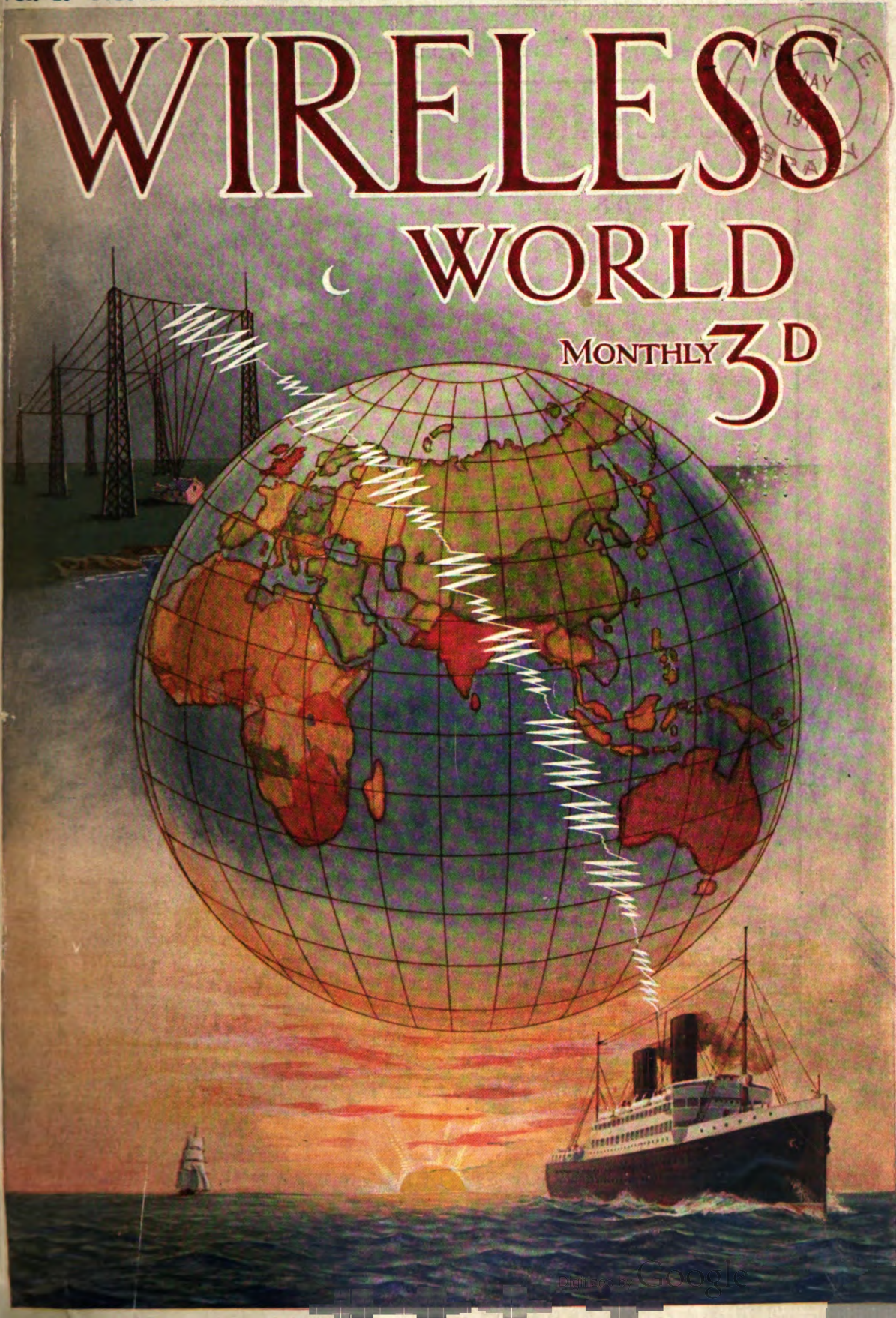

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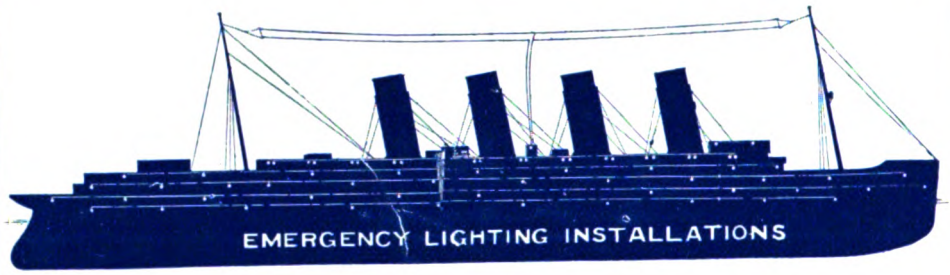

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All Editorial communications to be addressed to "The Editor, 'The Wireless World,' Marconi House, Strand, London, W.C."

The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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Vol. 1.—No. 1. (NEW SERIES) April, 1913.

Subscription 5/0 per annum post free.

Price 3d.
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"The Wireless World" and its Objects.

WITH this number THE WIRELESS WORLD makes its *début*. Its striking and appropriate cover, which we do not think will be regarded as devoid of artistic merit, should make it even more familiar than the red and black design which for two years adorned the cover of the popular MARCONIGRAPH, now merged into the present publication.

THE WIRELESS WORLD will still be the medium, as was THE MARCONIGRAPH, for the interchange of ideas concerning the further scientific and commercial development of wireless telegraphy, with its bearing upon national and economic interests. But these long words do not mean that we intend to take up the standpoint of a dry and educational science. Our Magazine is to be popular, and while the information we shall print will compel the attention of the scientist, it will not be beyond the scope of the general public.

But there is one especial feature in the development of wireless telegraphy which can no longer be overlooked, and which urges us to devote an important section in each forthcoming number of THE WIRELESS WORLD to its study—that is, wireless telegraphy as a factor in national defence. Its importance in this connection was made a subject of special reference by the delegates of the Government of the United States of America in their report to Congress upon the International Radiotelegraphic Convention signed in London last summer. They stated that particularly in Great Britain and Germany was the fact recognised that radio apparatus is an important weapon of war, and that international safety may be involved in the delay in developing and extending radiotelegraphy concomitant with the advance made by rival Powers.

If the situation has been accurately described—and we do not think there will be found anyone to doubt it—it raises the question of training for men who may be able to operate wireless apparatus and maintain communication with every part of the country in times of national danger. It is not enough to perfect the machine if there is no person sufficiently experienced to take charge of it. Here we think we can be of some service in creating a sufficient supply of trained operators to serve the State. Already we have made some advance in this direction by assisting organisations, such as the Boy Scouts' Association and the Church Lads' Brigade, to make themselves efficient in this branch of national service.

Now we have arranged for a special course of lectures for wireless amateurs to appear month by month, and at the same time we shall devote several pages to matters both topical and technical which may be of interest to such readers.

This, then, is our policy: to be of use and interest to our readers, and through them to be a factor for progress; and if the success of THE MARCONIGRAPH was indicative of public appreciation, we believe that THE WIRELESS WORLD is on the high road to popularity

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GUGLIELMO MARCONI, Esq., LL.D., D.Sc.

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Commendatore G. Marconi

APRIL 25th is a notable occasion for the wireless world—it is the birthday of Mr. Marconi. If such an occasion as this were to pass unacknowledged, the oversight would show great want of appreciation for a benefit intimately affecting the progress of man, and THE WIRELESS WORLD would deserve—and rightly deserve—the condemnation of its readers. But considerations greater than these urge us to wish Mr. Marconi many happy returns of the day. We are compelled by our admiration for his magnificent and public-spirited work, and by the realisation of the great benefits which he has conferred on humanity, to offer him the tribute of our good wishes.

The life of Mr. Marconi is too well known to need a repetition here. Born at Bologna in the year 1874, he first began to interest himself in the problem of wireless telegraphy in 1895, so that he was only twenty-one years of age when he first put to practical use Hertz's principle—that an electric spark brings about the radiation of electric waves, which may be reflected, refracted and polarised like those of light. With a power and insight which, if he had lived a century earlier, would have been deemed occult, he found the bridle which controlled this Pegasus of the air, and as a result our second Prometheus brought down to earth "radiotelegraphy."

It is difficult to explain the phenomenon of genius. It comes so seldom that it defies analysis. How is it given to one man to seize on a truth which, like a will-o'-the-wisp, has eluded the earnest and oftentimes painful and life-long researches of those who have gone before?

It does seem, however, that a genius may be accurately termed a mutant. A mutant is a species, be it a plant or animal, which springs up none knows whither. A well-known example is the copper-beech tree. The parents are ordinary and familiar trees which abound in the northern forests, but suddenly there arises a glorious scion of the race, more glorious than his ancestry, standing out a noble specimen of arboreal perfection, with leaves of magnificent copper throwing purple shadows, and, as they catch the glint of the sun, flaming up into innumerable tongues of shifting fire. In the same way a genius arises amongst the children of men.

But there is another extraordinary phenomenon to be observed with genius—that is, the swiftness with which his message is seized upon by the crowd and applied by them. A great truth which has required a brain above the ordinary to evolve, as soon as it has found a mouthpiece, is taken and adapted to the various needs of mankind, so that ere its reception is many years old it has become a glib phrase in the mouths of men. Again, if it is an applied discovery, it is handled and made use of, without question, by thousands who themselves would be utterly incapable of adding a jot or tittle to the sum of human knowledge. But the extraordinary part is that recognition is so often denied to its real possessor, and Galileo is imprisoned for his pains.

Fortunately this has not been the case with Mr. Marconi. The world has acknowledged its indebtedness to the great inventor, and nation has striven with nation to do honour to so universal a benefactor.

Mr. Marconi has followed his own splendid vision with an earnestness that would alone command admiration. His example has inspired those whom he has gathered around him to aid him in his work, and when we contemplate the noble edifice which his labour has set up we cannot but feel how well the words of a brilliant dramatist may be applied:

"With all time for its woof and all space for its warp—
Its web is so boundless, so majestic, so mysterious,
Stretched from star to star through the infinities,
That reverence becomes us better than criticism."

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NOTES OF THE MONTH

EXPLORING THE INTERIOR OF THE EARTH. PROSPECTS FOR WIRELESS TELEGRAPH ENGINEERS. RELIEVING BROKEN LAND LINES. THE "SCOTIA" AND HER MISSION. THE SHARE MARKET.

THE number of new uses for wireless telegraphy seems to have no end. For some time past a great deal of interest has been taken in "wireless," applied to aeroplanes and airships, and recently good results have been obtained which indicate that the application will have a great value in warfare. Now there comes another application, on lines, surely, as widely divergent from those just mentioned as is conceivable; for not only is it essentially a peaceful application, but geographically it presents an equally distinct contrast. In the last Home Office Report by the Chief Inspector of Mines there is an interesting passage dealing with recent experiments with wireless in mines. The experiments especially referred to have been carried out by rescue brigades and others in the North of England, and communication was established satisfactorily between the surface and the men in the workings close upon 800 ft. deep. No detailed description is given, and no hint is afforded as to which of the multitudinous ways of telegraphing wirelessly on such a miniature scale was adopted. On the whole, one would be inclined to favour for this purpose a return to some of the earlier forms, such as those studied by Sir William Preece about thirty years ago. A certain amount of care would have to be taken to avoid all risk of sparking being induced accidentally in metal bodies, such as rails, especially in coal mines; but apart from this, the problem does not appear to present any difficulty. It would seem that a system of telephony would meet the necessities of the case even better than telegraphy. The Report states that the experiments are to be continued, "as the possible advantages of such a means of communication are at once apparent, and open out a very interesting field."

Those in search of a career for their sons, and young men in technical colleges who are considering to what branch of engineering they should devote themselves in post-collegiate days, would be well advised to read carefully the article entitled "The Wireless Engineer," which appears elsewhere in this number. There they have a clear statement of the qualifications that are necessary for those who desire to enter the profession, and of the conditions which they will find when they get there. No attempt has been made to paint the prospects in the glowing colours that serve to attract the type of young man who wishes to find an "easy" vocation, for it must be evident to anyone who reads the article that the indolent mediocrity would be hopelessly unsuited for the work; nor, for that matter, is he desired. On the other hand, the earnest, hardworking, and capable student should seriously consider whether he would not serve his interests better by turning his attention away from the crowded branches of the engineering profession to one which affords him far greater scope for the display of his talents and the exercise of his individuality. Wireless telegraphy is a comparatively new branch of engineering, and is therefore not yet overcrowded. The work is of such a character that it tends to the development of a sound all-round engineer who is of greater value, and has a higher earning capacity, than the man whose experience lies in only one branch of engineering. With the prospect of extensive travel and a good salary, an able engineer and resourceful man should have no fear of his future success, and the field which still awaits investigation should act as an additional inducement to him. So important is the future of the wireless engineer considered that in some colleges special

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classes have been instituted with a view of equipping young men to follow this career, and we hope that these examples will not be lost on other directors of technical colleges.

* * *

The frequent interruption of the telegraph service in the north of Scotland, occasioned by severe storms in exposed parts of the country, has naturally led to the demand on the part of the local authorities in Aberdeen, Dundee, and Arbroath for some more reliable means of communication; and one of the suggestions made to overcome the trouble is the introduction of a wireless service. The adoption of wireless telegraphy is a solution of the difficulty which could be brought about without undue expense. Recent experience in the Channel and Scilly Islands, when heavy weather broke the cables, has rendered the inhabitants there enthusiastic for a wireless service resort to save local fruit and flower-growers from the heavy losses that threatened to result from the complete disorganisation of the cable service. Indeed, as we noted last month, so impressed was the Post Office with the value of the wireless service which was hurriedly established in the Channel Islands, that it has been determined to establish a permanent station at Fort George for use on future occasions of stress. Scotland could hardly do better than learn from the experience of the islands in the south.

* * *

The departure of the *Scotia* to patrol the waters of the North Atlantic, and to collect information regarding the movement of ice in that region, is an impressive reminder of our dependence upon wireless telegraphy for the safe navigation of the ocean. Memories are often short-lived, and in one sense it is well that we should be able to shake off the sad recollection of some ocean tragedy. But in the agreeable facility to forget there lies the danger of overlooking lessons by which we may profit on the recurrence of similar occasions. A disaster which brings home to us the uncertainty of life at sea not only stirs us to pity for the poor victims, but fires us with the determination to pursue the investigation of means by which the terrors of the sea might be mitigated; but it generally happens that the impulse to action weakens in proportion as the memory of the event fades. The mission of the *Scotia*, however, marks a different spirit, and the British shipping companies are to be congratulated upon the practical step which they have taken, in conjunction with the Board of Trade, to safeguard life and property at sea. The *Scotia* may prevent many a wreck by its timely wireless warnings of icebergs, and may even prevent another terrible disaster such as occurred last year. As she will have an expert meteorologist on board, she may also be useful in imparting information by her Marconi installation of the intensity of any cyclonic storms she may encounter, and by which other ships may be struck. It is not difficult to estimate the benefits which must accrue to shipping from the mission of the *Scotia*, and we should not be surprised if the results justified the work being undertaken annually on a larger scale. Further, it is not unnatural to suppose that it may lead to the development of a more complete organisation for the despatch of advices to the British Meteorological Office concerning the approach of cyclonic storms from the Atlantic. The first indication of the approach of these storms is now sent through stations on the west coast of Ireland, from between latitude 10 degrees and 16 degrees, and many of them are of great practical service in the preparation of meteorological forecasts for these islands. But with vessels of the *Scotia* type, scattered between England and America, direct meteorological information should be available from other parts of the Atlantic, which should make it possible to indicate changes in the weather some days in advance with a fair degree of accuracy.

* * *

Business in the share market has been at a low ebb during the past month. But, in spite of the comparative inactivity of dealings the tone of the markets has been decidedly good, as the result of a further improvement in the political situation in Eastern Europe.

Dealings in the shares of the various Marconi issues have been restricted, but the market has kept very firm.

Prices on March 19th were: Ordinary, 4⅛; Preference, 3⅞; Candadian, 15s. 6d.; Spanish, ⅞; American, 1.

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CARTOON OF THE MONTH

Wireless Terms Illustrated

"Sigs are Strong"

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The Gateway of the East

The Aden-Berbera Wireless Stations

The wireless service between Aden and Berbera has proved of special value for strategic and commercial purposes. Life for the Englishmen who guard these outposts of Empire is not a "feather-bed" one. The following article indicates something of what they have to endure, and incidentally turns the limelight on a fowl with a mania for punctuality.

THOUGH established barely three years—it was on May 14th, 1910, that the stations were completed and handed over to the Government—the wireless service between Aden and Berbera, which was primarily intended as part of the Defence Scheme, has proved so successful from a commercial point of view that attention is being directed to the question of establishing a station at Kismayu on the coast of British East Africa. Kismayu, the capital of Jubaland, lies almost on the Equator, and has no other means of communication than by steamer, which calls once a week from Aden and Berbera with mails and cargo. At Lamu, 180 miles south of Kismayu, it is contemplated to erect another station, and so complete a valuable "chain" from Aden to Mombasa, which is already in telegraphic communication with Lamu.

Aden, which in recent years has been christened the "Gibraltar of the East," assumed an additional strategic importance to the Empire when Britain decided to evacuate Somaliland and confine her activities to the coast. It was then thought expedient that Berbera should be in communication with the outside world. Hence the wireless telegraph stations.

It was, curiously enough, a shipwreck which added this second Gibraltar to Britain's possessions. Sailing under the British flag, a vessel was wrecked off Aden harbour in 1837, and the passengers and crew robbed and grievously maltreated by Arabs. When the Bombay Government demanded an explanation of the outrage the Sultan of Aden promised to make handsome compensation for the plunder of the vessel, and even agreed to sell his town and port to the English. While negotiations to this end were being undertaken by Captain Haines, of the Indian Navy, the Sultan died, and his son refused to fulfil the promises his father had made. A combined naval and military force therefore bombarded the port, which capitulated and was annexed to British India in January, 1839, being the first accession of territory recorded in Queen Victoria's reign.

Ere Britain, through the British East India Company, took the reins, Aden's career had been a chequered one. At many periods of history it held, as the chief trading city on the coast of Arabia, a big reputation. It has been identified, though rather speculatively, with the Eden of Ezekiel xxvii. 23, and was certainly an entrepôt of commerce between the ancient Roman Empire and the East. The Romans, indeed, probably captured it about 24 B.C.; to them it was known as Arabia Felix. But a few years after 1513, when the Portuguese under Albuquerque unsuccessfully attacked it, Aden fell into the hands of the Turks and was fortified by them in the reign of Solyman the Magnificent. Later it passed into the hands of the native Arab chiefs.

Shrunken almost to insignificance when it fell into Britain's hands, Aden—especially since the opening of the Suez Canal in 1869,

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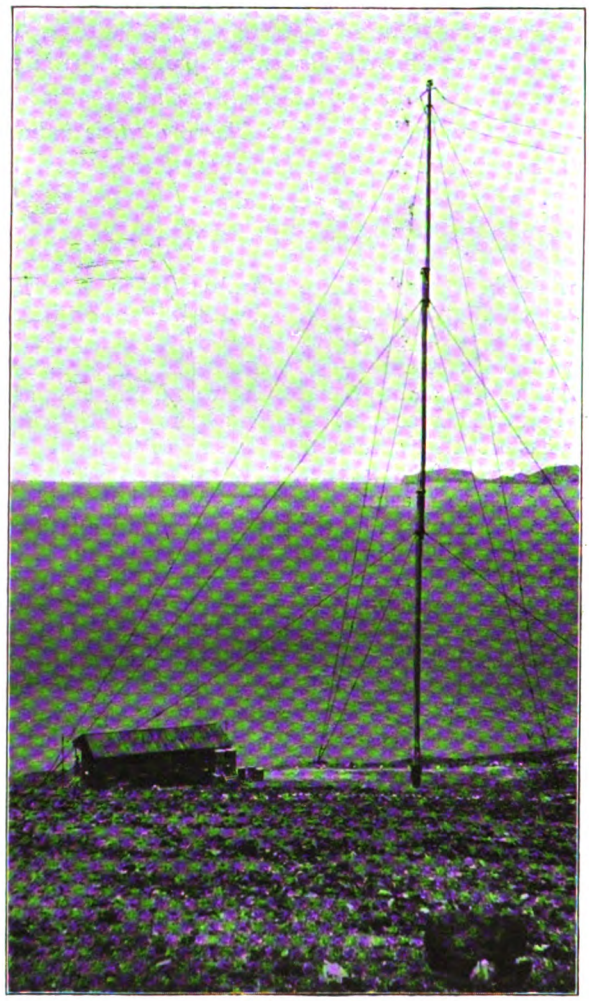
nineteen years before which it had been made a free port—has increased astonishingly in commercial importance. Every year over 2,500,000 tons of shipping visit the port, from which Arabian coffee, gums, spices, ivory, ostrich feathers, hides and pearls to the value of £2,250,000 are exported.

Aden strikes the eye as purely utilitarian; it is a great strategical position, a vast natural fortress, and that is all. From an æsthetic point of view it is "damned with faint praise." Drear and desolate is its aspect from the sea; like a lifeless drop-scene, its precipitous bulk stands barren against the limpid waters of the bay. Like shanties on a cinder-heap, sundry buildings sprawl about its base as colourless as the mountain behind them. It is a drab spot, this scorched volcanic waste, one that not even the most ardent house agent could label as "desirable locality."



Aden Wireless Station

Yet people, apart from the garrison, do live there—a cosmopolitan crowd of 45,000. Why, heaven alone knows! Perhaps on nearer acquaintance Aden, like cheese, improves. The town, a depressing collection of stone and mud buildings, a few of which attain to the dignity of two stories, and the military cantonment—the Aden brigade belong to the western army corps of India—are within the crater; the Europeans have pitched on Steamer Point as a rather cooler spot. Here in a fiery but not unhealthy atmosphere the little world of Aden, importing all its food, endures life perpetually athirst. Aden is as dry as a bone. A little water is obtained from the wells within the valleys of the crater; much is condensed from sea water; for washing, it is led by means of an aqueduct from Shaikh Othman.

Next to the camels, a quarter of a million of which lope into Aden annually with produce from all parts of Yemen, and squat, chewing, chewing, chewing, in herds about the highways to the great inconvenience of the pedestrian, the great feature of the place is, if one except the snakes, the scorpions and the printing press in the local gaol, the water tanks.

In a hill gorge just above the old Arab town they lie, basins of rock to store the occasional heavy showers in the hill region. They were probably first made about 600 A.D.,

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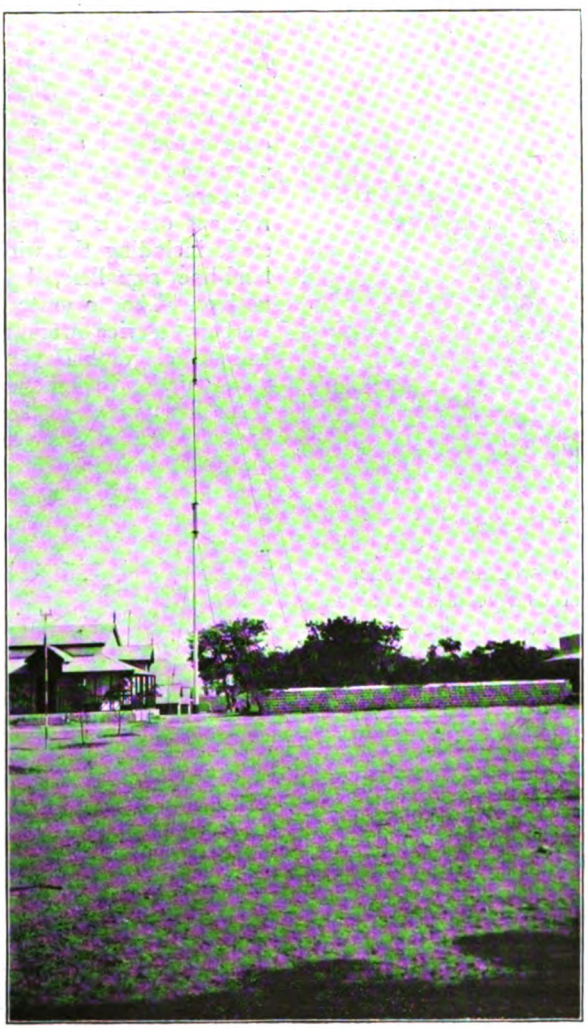
when Aden was a calling place for Arab and Egyptian vessels engaged in trade between the Red Sea and Somaliland, Southern Arabia and Western India. There are now some thirteen of these, capable of holding nearly 8,000,000 gallons of water; but there are said to be in all fifty, which, if entirely cleared out, would have a capacity of some 30,000,000 gallons. Thus, then, is displayed the vital importance that has been attached to the water supply in this arid region.

The earth round the tanks is rich with tropical vegetation, on which the eyes, weary of dust and rock, rest with gratefulness. In the hill gorges a wealth of lilies, acacias and aloes occasionally surprises the eye; here are the grape-vine, the figs, the date-palms and even frankincense trees, which famed Aden abroad as Arabia Felix amongst ancient nations. Even now Aden ships large quantities of incense to the Mohammedan States of India.

But Aden without the P. & O. boats would be like Cambridge without the university. The whole occupation of the natives would be gone. In a fog of coal dust, when you drop anchor, a hundred naked urchins swarm up the side of the vessel to dive for coppers or tickle your nose with ostrich feathers—and ostrich feathers that are palpably shams at that. Ostrich eggs, coloured hand-made baskets, feather boas, and "West End style" cigarettes that an East-Ender would pay not to smoke, the returning citizens of a great country have thrust on them at prices which steadily diminish as sailing time draws nigh. Salesmanship in Aden has reached the high-water mark of insistence, or Aden could not live. He is a strong man who can withstand their importunities—or smoke their cigarettes.



Berbera Wireless Station

On the Elephant's Back, a rocky promontory sloping down to the sea three miles from Steamer Point, off which the native chafferer daily "does" the Britisher tourist, lies the Aden wireless station. Above it stands Marshag Lighthouse. The erection of the Aden station was quite a notable feat of construction owing to the difficulty of approaching the site by road. Required in a moment of urgency, the houses to contain the installations were shipped out from

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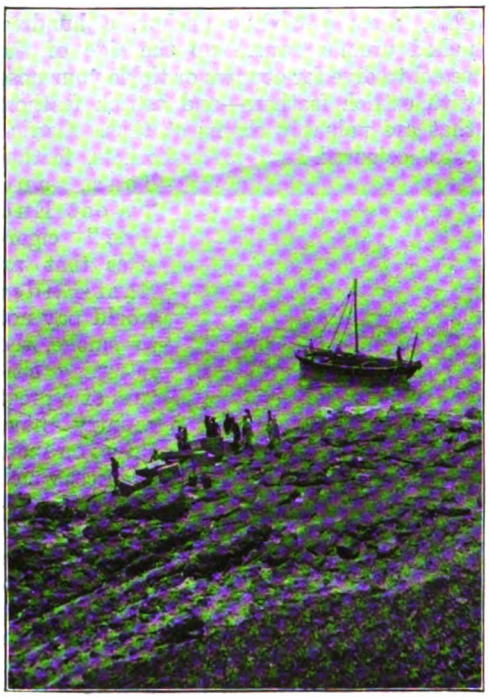


Landing material on Elephant's Back

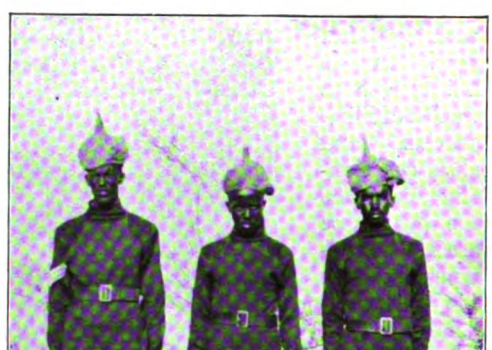
England in portable wooden sections, the intention being to erect a permanent station at a later date. Arrived at Aden, the plant had to be landed on the beach and hauled up the precipitous slopes to the chosen site. Under a broiling sun the work went on expeditiously and was finished well within contract time.

The Aden installation is a Marconi 1½-kw. standard set, consisting of a rotary converter, transforming half-plate condensers, bulb spark discharge, adjustable transmitting jigger, chokes and inductances in the transmitting gear, and multiple tuner and magnetic detector in the receiving circuit. The power is derived from a 5 B.H.P. oil engine, and the battery consists of 54 cells of 150 ampere-hour size. The aerial is suspended from a mast 185 ft. high, the wires being carried out to 50-ft. extension poles. The aerial, a "four wire one," is arranged partially directionally. The Aden station is connected by land line to Ras Boradli, the Eastern Telegraph Company's cable station in the town.

Due south of Aden across the Gulf lies Berbera. It is the one green spot in a sandy plain which stretches away twenty miles to a high range of hills which are said at one time to have formed an unbroken chain from Somaliland to the volcano at Aden. The green relief is a plantation of trees round the Residency and Government bungalows. This oasis is known as "the Shaab." Surrounded by a 10-ft. wall with gun bastions at intervals, it is strongly fortified and guarded by a company of Indian soldiers. Within this area is the wireless station. The mast is erected just outside the gaol, and the aerial wires extend over the military lines.

There are less than a dozen European resident officials on the coast, the clerical staff, including the wireless operators and land-line signallers, being Eurasians and natives. The operators for the Aden-Berbera service were recruited from the Indian Telegraph Department, without previous wireless experience, and have shown themselves good and keen workers. Three operators and one engineman comprise the staff at each station. At Berbera two Somali telegraphists who had been working on the local land lines were trained as wireless men.

Since the opening of the Aden-Berbera



Linesmen attached to Land Lines

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service for the exchange of public telegrams the traffic has increased every month, the chief source of revenue to the stations being from messages received from ships. Local merchants use the service to some extent in connection with the fluctuating prices of the country's chief exports—live stock and hides. Valuable meteorological information is transmitted from Aden, from whence, too, assistance can be readily obtained, as the cases of the *Trieste* and the *Fifeshire* prove. It is hoped shortly to recommence the daily transmission of Reuter's news telegrams to Berbera. This will mean the handling of a quarter of a million additional words annually.

For six months of the year Berbera awakes from its apathy, and its normal population increases from 10,000 to 30,000. From October to May the town hums with life. This is the time of the Great Fair, to which come hundreds of caravans from Ogaden and Dolbahanta carrying the produce of the interior. Camels and vans pitch in the native town one mile from the "Shaab"; tents are unslung and mingle quaintly with the one-storied, flat-roofed, rubble native houses. All day long the din of bargaining is heard; sheep and goats, gum, resin, skins and ostrich feathers add an atmosphere to the picture. May comes and the hucksters steal silently away; Berbera looks quite deserted.

The Europeans enjoy a little fishing and tennis.

Not an eyebrow has been raised by the Somali at the introduction of wireless telegraphy at Berbera. The machine guns and traction engines of great expeditions into his country have come and gone, and nothing that the white man can produce will occasion him any further surprise. Besides, the Somali suffers from *Wanderlust*, and his travelling has made him wise and taught him a familiarity towards things mechanical.

A little hobby of several notable Somali chiefs is to come down to the station to see "the devil," "the devil" or *shitan* being the spark, in the presence of which they exhibit, it must be confessed, a particular good-humour.

A View of Aden

"Wireless" has pleased another section of the community in another way. Berbera is by no means a cool spot. Indeed, in the hot weather from May to September, when the "Khariff" or hot blast blows continuously for days, the temperature not seldom rises towards 120° in the shade, and in the cool season is seldom lower than 90°. The recent "winter," if it may be so termed, was exceptionally cool and extraordinarily cloudy. For this boon many old native residents in the bazaar are blessing the "wireless," to which they attribute a season of unusual comfort.

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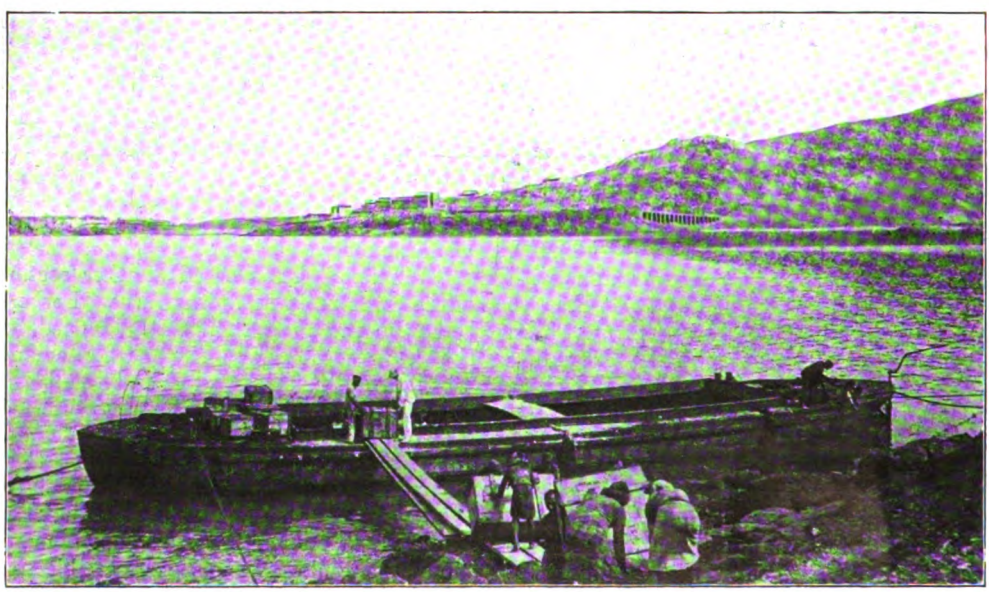
Beluchi soldiers doing concrete work at Berbera

Finally, amongst all the boons that wireless has showered on the Berbera community, it has done splendidly for the local eagle.

Promptly at 6 p.m. every night the fowl alights upon the wireless mast. He has not missed his way for a year of nights. Hunched upon the truck of the top-gallant, he roosts —the Mascot of Berbera.



The difficulties of landing materials at Aden. 150 ton lighters must be anchored well out through danger of breaking on the rocks

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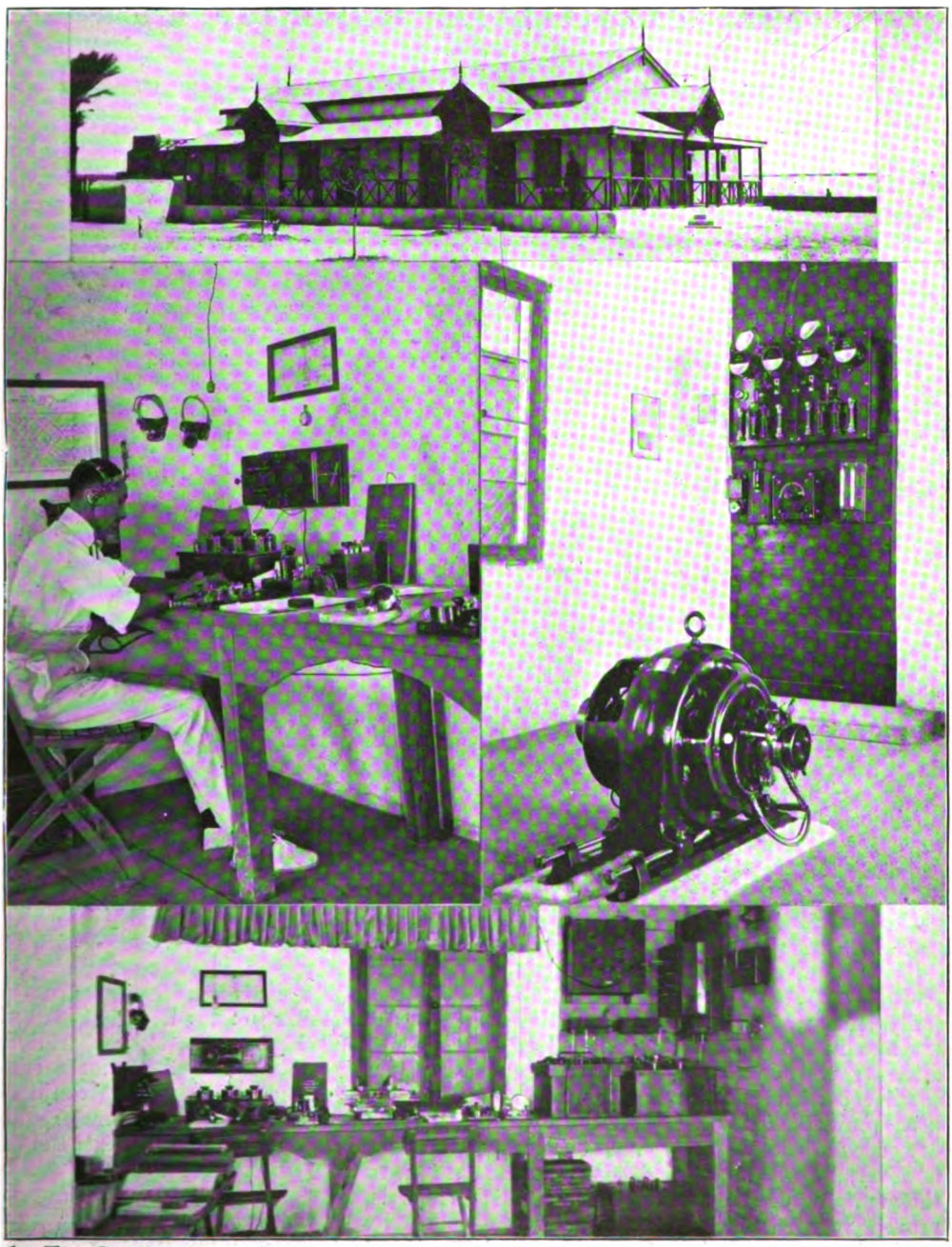
Berbera Station



1. The Station. *2. Operator Receiving.* *3. Converter and Switchboard*
4. Instrument Room.

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An Atlantic Sentinel

The *Scotia* and Her Wireless Equipment

SIR H. LLEWELLYN SMITH, when he went to Dundee on March 8th to speed the men who went out in the *Scotia* to patrol the waters of the North Atlantic and report to ships that pass in the night or the day when and where there is danger from icebergs, conveyed to Captain Robertson, the scientific staff, and the crew a message from the King, expressing his Majesty's special interest and good wishes.

Although the *Scotia* is a full-rigged ship, she is also fitted with engines of 80 h.p., which are capable of driving her at a speed of six or seven knots. Two dynamos have been added to the engine room, each designed for an output of 5 kw. Electric lighting plant has been installed, but the main object of the dynamos is to supply current for the wireless plant and other smaller motors in connection with the various scientific instruments on board.

The vessel is fitted with a Marconi wireless installation having a long range, so that she will be able to keep in touch with the wireless stations in Newfoundland and Labrador. This apparatus has been provided free of charge by the Marconi Company. There are two wireless operators on board the vessel.

A standard 1½-kw. set and emergency gear have been provided, but the station enjoys the advantage of a disc-discharger. The space for the wireless cabin is necessarily small; nevertheless, accommodation was found for a silence cabin. Considerable difficulty was experienced in obtaining a suitable earth connection, as this had not been provided for when the ship was in dry dock. The difficulty was overcome, however, by making a good connection to the upright of the main engine. This proved very satisfactory, as signals were received from Paris, Germany, and Poldhu.

The aerial is, unfortunately, exceptionally small, as the span from foremast to mizzen-mast of the vessel is only 87 ft.; this was compensated for by adding 50 ft. from the foremast down to the bowsprit, which gave a total length of aerial of about 200 ft.

Dundee, where the *Scotia* was fitted, is rather isolated from a wireless point of view, Cullercoats being the nearest public station with which to conduct tests. Thanks, however, to the timely aid of Captain Young, of the Board of Trade, arrangements were made with the Admiralty whereby it was possible to test with H.M.S. *Venus*, and almost at the eleventh hour this ship, which was lying at anchor in the Firth of Forth, reported signals very strong.

As the *Scotia* sailed from the Tay she presented a strange appearance to those of her crew who were familiar with her as a "whaler"; for, under the able supervision of Mr. Boumfrey, of the White Star Line, she was so transformed as to resemble a yacht, with comfortable quarters for her crew.

If scientific instruments of the latest type can accomplish anything, then the success of the *Scotia* should be assured, as the deck literally abounds with weird devices of every description for taking various observations.

A lead pipe runs from the mast-head to the laboratory for measuring various air pressures. Aft is to be found a device somewhat similar to a log line; but instead of the usual thin rope, an electric cable is used. This cable is trailed aft for a considerable distance, and is used in conjunction with the electric thermometer, an instrument so delicate that readings can be taken to the 1/100 part of a degree. Amidships is the laboratory, where all experimental work will be conducted.

A code for use in transmitting wireless reports on ice to the nearest land stations and the steamships on the trade routes has

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been issued by the Board of Trade. The information required concerns :—

(1) The kind of ice observed; (2) the position of ice when last determined; (3) the direction and rate of its drift when known; (4) the direction and force of the wind; (5) the set and velocity of the current; (6) weather or state of the sky at a fixed hour; (7) barometer and air temperature; (8) barometric change and sea temperature.

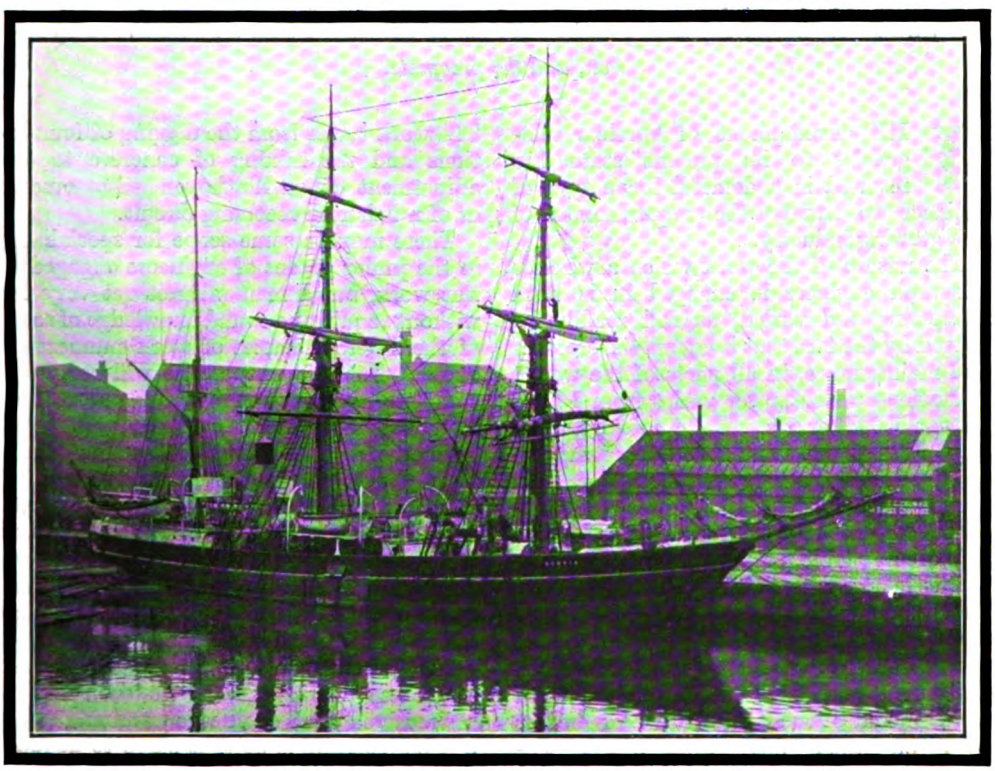
4. Floe ice. Pieces of field ice frozen together.

5. Pack ice. Collection of pieces of ice broken from berg or floe, which have more or less closed together.

6. Hummocky ice. Field or floe ice presenting hillocks.

7. Pancake ice. Cakes of newly formed ice (navigable).

8. Brash (or Sludge) ice. Small p[illegible] ice (easily navigable).



The "Scotia" as she appeared before leaving the Tay

Messages are to be addressed "Meteorology," the absence of any further address indicating the universality of the destination of the warnings.

The code adopted for describing the nature of the ice is :—

0. No ice observed.

1. Iceberg. Huge mass of floating ice.

2. Floeberg (or Growler). Thick piece of salt-water ice like small iceberg.

3. Field ice. Navigable flat ice, extending as far as the eye can reach.

9. Land ice. Field or floe ice attached to the shore since the winter.

The messages will also detail the date, position of the ship, the position of the ice, the date and time of observation, the direction and rate of drift of ice, the direction and force of the wind, the set and velocity of the current, the weather, barometer, and air temperature at eight a.m., the barometric tendency, and the sea surface temperature. All this information will be conveyed by the code in six groups of five figures each.

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The Wireless Engineer

Qualifications and Prospects

The article below can be specially recommended to parents and guardians who are considering what to do with their boys, also to young men in technical training colleges who are preparing for a career. It explains what qualifications are required of wireless engineers, the nature and conditions of the work which they have to carry on, and the prospects.

THE development of wireless telegraphy to its present state has resulted in a demand for a type of engineer to satisfy the requirements of this growing industry.

The nature of the work which a wireless telegraph engineer is engaged in is both interesting and varied, as will readily be judged by the fact that it covers the erection and maintenance, in all parts of the world, of stations whose power varies from ½ kilowatt to 500 kilowatts. In the case of a small ship station the installation is, comparatively speaking, a very simple matter. The accommodation and the power are provided by the ship, and the masts of the ship are available for the aerial wires.

But in the case of a high-power station, its erection in a comparatively uncivilised part of the world is a work which requires the resources of first-class mechanical, electrical, and civil engineering. Such work includes the installation of boilers with all their accessories, steam turbines, direct current and alternating current machines, accumulators, switchboards, transformers, etc., in addition to the wireless gear. It also includes the erection of a number of very large masts with the corresponding systems of aerial wires and earth wires.

It might very easily include the construction of buildings and roads, and, as a contrast to all the foregoing, requires the careful tuning and adjustment of the transmitting and delicate receiving apparatus, and, finally, the organisation of a telegraph business which has to work as regularly as if it were on an ordinary land line. The work varies from the digging of foundations and the mixing of concrete to the adjustment of an Einthoven galvanometer or of a balanced receiving circuit.

There may be some scope for specialising in the junior grades of engineers engaged in this work, but a man will not get very far without acquiring a sound knowledge of some of the different classes of work enumerated above. For this purpose he will require a complete general engineering education, including mechanical, electrical, and civil engineering. The order in which these three branches are mentioned may be taken as indicating their relative importance for this work. In the early days of wireless telegraphy the work was of a more purely electrical nature, but this is not the case now. It is the engineer rather than the electrician who is required.

The wireless telegraph engineer should commence on this work as soon as he has received a full engineering training. He will be better able at that stage to acquire the knowledge which specially concerns wireless telegraphy than if he begins later when his mind is set. He need not trouble to acquire any special experience of wireless telegraphy before starting on the work (it is not required of him when he joins), though he will, of course, benefit considerably by reading in his spare time books or articles dealing with the subject. His principal object should, however, be to obtain the best general engineering training that he can afford. There need be very little doubt, nowadays, as to the way in which to set to work to do so, as the most excellent advice on

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the subject is given in the following publications:

"Notes on the Training of Professional Engineers," by Professor John Goodman,* and the "Report of the Committee of the Institution of Civil Engineers on the Education and Training of Engineers." †

The specific qualifications required by Marconi's Wireless Telegraph Company of applicants for posts on their engineering staff include the following:

1. A good general education till the age of not less than 16.

2. A suitable general engineering education at an approved technical college or university for not less than two years, with the corresponding certificate, diploma, or degree.

3. Not less than two years' practical experience in a mechanical engineering workshop or other suitable place.

With regard to the nature of the practical work, the most suitable experience would include fitting, turning, forging, assembling, and outside installation of engines, including foundations and the lining up of bearings. Also, if possible, experience in the maintenance of steam plant. Experience as a switchboard or sub-station attendant is not of much use. Experience in large electrical manufacturing works is usually distinctly less useful than experience in moderate-sized mechanical engineering workshops, though there are exceptions to this rule.

It must not, of course, be supposed that a good training will necessarily make a good engineer, and, on the other hand, a capable man can sometimes acquire a good training by methods which differ considerably from those which are generally recommended. In certain cases, therefore, applications are entertained from men who have not exactly fulfilled the letter of the requirements mentioned above.

In addition to adequate training, it goes without saying that a thoroughly sound personal character is required, in evidence of which the strong recommendations of independent persons of good standing are required in support of the application.

As a great part of the work is carried out abroad, robust health and willingness to go at any time to any part of the world form part of the required qualifications. For this reason applicants for appointment are required, if approved in other respects, to furnish the company with a certificate of fitness from a doctor nominated by the company.

If an application appears to merit consideration, the applicant is granted a personal interview in London, with a view of determining his suitability for the work.

The average age at which men are engaged is from 21 to 25.

Men who are considered satisfactory in every respect are taken on probation for a period of three months, with an allowance which is intended to cover the cost of living only, and if a satisfactory report on their conduct and work is received at the end of that time, they are appointed to the engineering staff at a salary which depends on their previous training and experience, and on the nature of their probation report. Generally speaking, the scale of pay is fully up to the best standards of remuneration for fully trained engineers.

The probationary period is ordinarily spent at a special training station, where instruction is given in the principles of wireless telegraphy and in their practical application. As this instruction is of a confidential nature, the probationer is required to sign a strict agreement framed with a view of determining the conditions of his employment, and of securing to the company the full benefit of his services and his knowledge.

As regards general conditions of life, reasonable arrangements are made to cover a man's expenses when he is moved from one place to another. He is expected to be prepared to move at short notice at any time. There is consequently a good deal of change in the early years of a man's service, which is agreeable to a single man, but which would not be likely to suit a married man. The service probably provides unrivalled opportunities to engineers to see the world, as the pages of this Magazine will testify. When engaged on work abroad, a man ordinarily has his living expenses paid, in addition to his salary, and if the climatic or other conditions are bad, he receives a larger salary, each case being decided on its merits.

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* Obtainable from the Secretary of Leeds University.

† William Clowes & Sons, 23 Cockspur Street, London, S.W. Price 7d. post free.

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The Propagation of High-Frequency Electric Waves along Wires

By JOHN STONE STONE*

Mr. Stone deals thoroughly and authoritatively with a new and promising development in the science of communication. He outlines the fundamental ideas of the method in its simplest form, and describes its application to a pair of duplex stations for two-way transmission for each station, then proceeds to the "more complex, but more perfect" multiplex stations.

FOR the past three years or more Major Geo. O. Squier, of the Signal Corps of the United States Army, has conducted a systematic investigation of the propagation of high-frequency electric waves along wires, and of the practicability of their use in the transmission of signals and of speech along actual telephone cables and air lines. His investigations have also dealt with electrical resonance as a means of segregating, at the receiving end of the line, high-frequency currents of different frequencies simultaneously propagated along the line, and the selective reception of the energies of these different currents, each in a different receiver circuit made responsive only to the variations in the amplitude or strength of the current it is resonantly tuned to receive. The results of his labours are to demonstrate that not only Morse signals but speech may be transmitted over the ordinary telephone cable and pole line circuits, and to very considerable distances, by means of high-frequency electric currents or waves, and that a large number of telegraphic or telephonic messages may thus be transmitted simultaneously over a given telephone or telegraph circuit without interfering with each other through the use of electrically tuned or electrically resonant receivers. Moreover, he has shown that the new high-frequency multiplex telegraph and telephone system may be superimposed on the older systems or the new high-frequency apparatus added to lines equipped with the usual telegraph or telephone apparatus without interfering in any way with the operation of this older apparatus, or being interfered with by it.

Major Squier has dedicated to the public his patents relating to this new art—an act which, though laudable in the spirit it displays, is nevertheless unfortunate, as it is more likely to retard the progress of the new art than to advance it, since what is everybody's business is nobody's business, and capital may hesitate to enter a new field and promote an undertaking in which it is led to believe that it will meet with unrestricted competition as the reward for its enterprise.

ULTRA-SOUND FREQUENCIES.

The frequencies of the electric waves or currents propagated along the wires in this new art are, so to speak, "above the limit of audibility of the receivers" or are ultra-sound frequencies. In other words, each of

* Abstracted from the Journal of the Franklin Institute.

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the electric currents propagated along the telegraph or telephone line is of so high a frequency that it can produce no audible effect in the telephone receiver through which it passes as long as its strength or amplitude remains constant. In fact, the frequencies of the currents used in this new telegraphy and telephony are 20,000 or more alternations per second, and correspond, therefore, to the frequencies of the air vibrations of sounds whose pitches are above the limit of audibility of the human ear. In the new telegraphy and telephony the telegraphic signals and the voice are transmitted over the line wire by suitable variations in the amplitude or strength of the otherwise uniform high-frequency current, and the signals and the voice are received in a magneto-telephone receiver connected in a local circuit which includes a device capable of rectifying the high-frequency current used. The rectifier employed is preferably an Audion, though a Wollaston electrode, and perhaps other radiotelegraphic detectors, particularly the so-called crystal rectifiers, may also prove serviceable.

The rectifier in the local circuit at the receiver converts the high-frequency current of the line wire into a pulsating current of double the frequency, or, what is the same thing, it converts the high-frequency current into a normally uniform unidirectional current with a superimposed alternating current of double the frequency of the line current. The telephone receiver is mute to the alternating component of the rectified current, but responds to the most minute variations in the strength of the unidirectional component of this current. Variations in the amplitude or strength of the high-frequency line current are faithfully reproduced in the strength of the unidirectional component of the local receiver current, and in this way the telephone receiver is made highly sensitive to variations in the strength of the high-frequency line currents, while absolutely mute to that current when its amplitude is constant.

The relation of the new high-frequency telegraph and telephone to radiotelegraphy and radiotelephony is to be readily seen in Fig. 1, which illustrates the new system in its simplest practical form. The diagram shows, in fact, two radiotelegraph or radiotelephone stations with a connecting wire between them to guide the waves from the transmitter to the receiver.

In this arrangement the current is supplied by a high-frequency alternating current dynamo, A, which must be capable of supplying 20 watts at 10 volts and at not less than 20,000 cycles per second. In the case of high-frequency telephony this dynamo has to meet a further requirement which is not demanded of it by high-frequency telegraphy, and this requirement is perhaps the most difficult one to satisfy. It is that the amplitude of the current the dynamo supplies must be absolutely smooth and can have no variations or ripples on it of periods corresponding to the periods of audible tones.

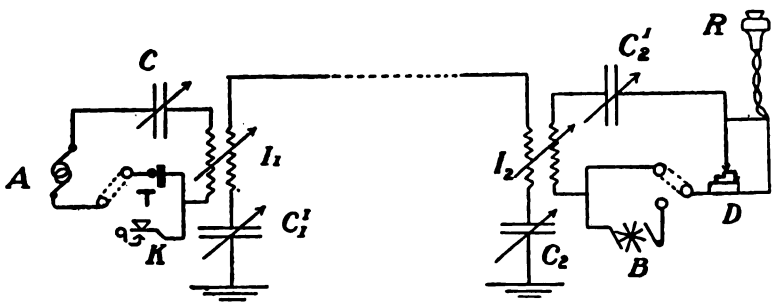

Fig. 1.

The arrangement of apparatus illustrated in Fig. 1, when the switches at the transmitter and at the receiver are both thrown up as shown, is that of a high-frequency telephone system, while when the switches are both thrown to their lower contact points the arrangement becomes a high-frequency telegraph system, so that the one diagram may be used to sketch the operation and requirements of both the new tele graph and the new telephone.

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AN ESSENTIAL DIFFERENCE.

In the new telephone system, when the transmitted T is spoken to, it modifies the amplitude of the high-frequency current in the primary circuit of the induction coil, I_1, in exactly the same way that it modifies the strength of the battery current in the primary circuit of the induction coil in the old telephone system, and, as already described, the telephone receiver, R, at the receiving station responds, owing to the fact that exactly corresponding fluctuations result in the unidirectional component of the rectified current in the local circuit at that station.

In the new telegraph system the operation of the new telegraph key, K, to send Morse signals, alternately throws the high-frequency current on the line, and cuts off the supply of this current from the line. The result of this would be only to make successive faint clicks in the telephone receiver, R, as the current is thrown on and off, except for the periodic interrupter, B, which may be of the nature of a revolving commutator or a mere buzzer. This interrupter serves to break the incoming wave trains constituting the Morse signal elements into a succession of much shorter wave trains having a frequency of about 450 impulses per second, which, when rectified, give rise in the telephone receiver to a high-pitched musical tone of great audibility. The Morse signals are now audible as a succession of long and short intervals of a high-pitched musical sound, as in radiotelegraphy. From the foregoing and the diagram of Fig. 1 the essential difference between the new telegraphy and the new telephony will easily be seen.

SOME CHARACTERISTICS.

Some of the more essential characteristics of the simple system shown in Fig. 1 may prove of interest, particularly as they have not as yet, so far as I am aware, been clearly set forth. The induction coils, I_1 and I_2, are wound without any iron in their cores, since in the first place the presence of iron is not needed to secure a large mutual inductance between the primary and the secondary circuits, because a high degree of coupling between these circuits is not desirable, and, in the second place, the presence of iron in the core of the coils would introduce a loss of energy, through hysteresis, owing to the high frequencies used, which would give rise to an effect equivalent to the presence of a considerable dissipative resistance in the primary and in the secondary circuits. The arrow through the symbols for the coils indicates that these coils are adjustable with respect to their degree of coupling in the same way and for the same reason that the coupling of the corresponding coils is made adjustable in radiotelegraphy and radiotelephony. Similarly, the arrows through the symbols for the condensers, C_1, C'_1, C_2, and C'_2, indicate that these condensers are of adjustable capacity.

The function of the variable condensers at the transmitting and receiving stations is to electrically "tune" these stations. In the transmitting station of the system shown in Fig. 1 the so-called tuning is quite different in the case of the telephone and telegraph systems. In the case of the telegraph the coupling of the coil I_1 and the capacities of both condensers at the transmitter are adjusted with reference to the production of a maximum current in the line wire, as indicated by a hot wire ammeter connected in the secondary circuit. In the case of the telephone system the coupling of the coil I_1 is made very small, and each of the condensers at the transmitting station is then independently adjusted to make the current in the circuit in which it is included a maximum, as indicated by hot wire ammeters connected in each circuit. The coupling of the transmitter coil is then increased till the tuning adjustment of one circuit interferes with the tuning adjustment of the other, and the circuits are readjusted, each by its own condensers, for a maximum of current in itself. The reason for the radical difference in the tuning of the transmitter station in the telephone and telegraph systems may not be obvious. It is due to the fact that in the telegraph it is the actual amplitude of the high-frequency waves propagated along the line that determines the strength or loudness of the signals heard in the receiver, while in the telephone system it is the magnitude of the variations in amplitude of the high-frequency waves propagated along the line that determines the loudness of the received speech. Moreover, in the case of the telegraph the loudness of the received signal is the sole object, while in

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the case of the telephone a still more important requirement is excellence in the quality or articulation of the transmitted speech. In the case of the telegraph, therefore, the adjustment of the transmitter station is such as to produce the maximum amplitude of the transmitted waves, while in the case of the telephone system the adjustment is primarily adapted to securing the best quality of the transmitted speech, and, incidentally, to produce the maximum variation in amplitude of the transmitted waves.

VARIATIONS IN AMPLITUDE.

Thus, by loosely coupling the primary and secondary circuits at the transmitter and then adjusting the primary circuit for a maximum of current, the reactance of the primary is made zero, and the impedance of the primary is reduced to the mere resistance of that circuit, so that the resistance of the telephone transmitter becomes practically the sole factor in determining the primary current. Obviously this makes the variations in the amplitude of the high-frequency current due to variations in the resistance of the telephone transmitter a maximum, and, on the other hand, telephone engineers will realise that the elimination, so far as possible, of all reactance and resistance except that of the telephone transmitter, from the primary circuit at the transmitter station, is a requisite to good quality or articulation of the transmitted speech.

At the receiving station of the system shown in Fig. 1, whether it be used as a telegraph or telephone system, the tuning of both primary and secondary is directed merely to the production of a maximum current in the secondary circuit, and for this tuning the telephone receiver is used as the indicating device, since the current at the receiving station is not sufficient to permit of the use of a hot wire ammeter. A sensitive galvanometer may sometimes be used with advantage for tuning purposes in place of the telephone receiver.

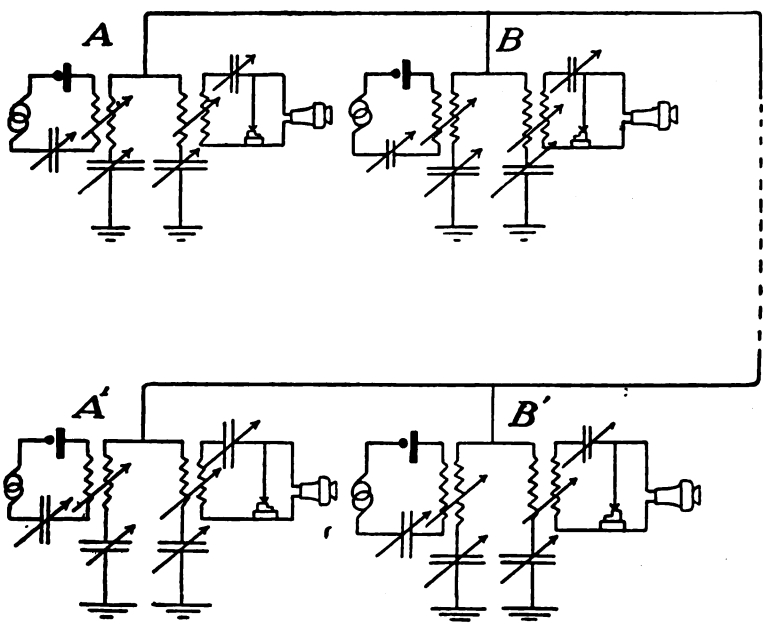

Fig. 2.

THE MULTIPLEX SYSTEM.

[Having thus outlined the fundamental ideas of the method in the simplest form, Mr. Stone goes on to describe its application to a pair of duplex stations for two-way transmission for each station, which he illustrates by Fig. 2, and then proceeds to the "more complex, but more perfect" multiplex shown in Fig. 3.]

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In Fig. 3 the receiver circuit is shown alone, and it is to be noted that in the branch from the line wire there are two loop circuits, 1 and 2, each consisting simply of a condenser and a coil. These loop circuits are each made resonant *per se* to one of two frequencies, currents of which frequencies it is particularly desired to exclude from the receiver. Thus, if this receiver were to be used at stations A or B of Fig. 2, its loop circuits 1 and 2 would be individually made resonant each to one of the two frequencies generated by the transmitters of stations A and B; while if it were used at one of the stations A′ or B′, its loop circuits would individually be made resonant each to one of the two frequencies generated at the transmitters of stations A′ and B′. The effect of the presence of one of these looped resonant circuits in the receiver branch is practically to make the branch electrically opaque to currents of the frequency to which the loop is made resonant.

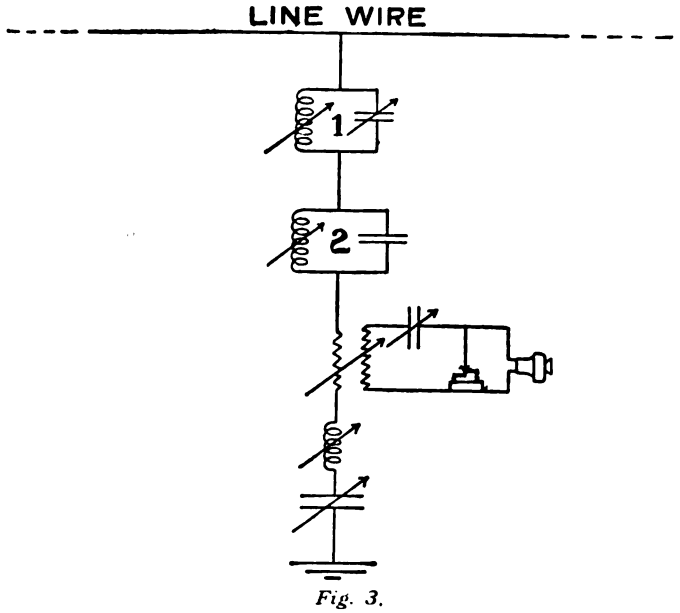

Fig. 3.

RECORDING OF SIGNALS AT THE TRANSMITTING STATION.—It has for some time been recognised that a record of all signals sent out from a station should assist in the smooth working of traffic; for such a record, if taken in the right manner, would not only show at once if the transmitting apparatus were working properly or if its action could be improved by some adjustment, but also it would decide, in the case of an error in transmission, whether this was the fault of the transmitting operator or of the receiving operator. In order to perform these functions, the record should be taken from the signals actually leaving the aerial, and not from any earlier source, such as the current from the manipulating key. Various methods have been tried with more or less success; the aerial current has been made to induce a spark in a subsidiary circuit, and the spark made to record, either by puncturing or by chemical action, on a moving strip of paper. In another method, a small fraction of the aerial current has been rectified in some manner and made to work a recorder.

But certainly one of the simplest methods, and a very successful one, is that recently introduced by the Marconi Company at some of their stations. A circuit comprising an ordinary Morse inker and a suitable battery is interrupted by a very short spark-gap with large sparking surfaces. The air-gap naturally behaves as a complete break in the circuit under ordinary conditions. When, however, signals are being sent out from the aerial, these are made to produce a spark across the gap, which breaks down the insulating properties of the gap and allows the battery to force a current through the inker so long as the signals last. In this way the signals sent out from the aerial leave a complete record on the Morse tape.

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The Use of a Condenser as a Shunt to a Telephone

By H. SMITH, B.Sc.

The author examines the conditions under which the telephone receiver is employed in wireless telegraphy in order to determine the most advantageous relations between the constants of the various parts of the circuit.

IN practically all systems of wireless telegraphy the telephone receiver has superseded all other forms of reception, and it is, therefore, a matter of importance to examine the conditions under which the telephone is employed in order to determine the most advantageous relations between the constants of the various parts of the circuit. This is considered in a paper which appears in the Proceedings of the University of Durham Physical Society.

It has been found for the telephones used in practice that the best results are obtained when the telephone is shunted with a capacity. The best value of the capacity depends, among other things, on the telephone, and the practical rule has been that the greater the resistance of the telephone the less the value of the capacity to give the loudest sound. It is sometimes stated that the function of the capacity is to form an easy path to the oscillations past the telephone whose inductance when introduced into the oscillating circuit would otherwise seriously enfeeble the current strength. That this explanation is insufficient is clear from the fact that there is an optimum value of the capacity. It was with the object of affording an explanation of this phenomenon that the following work was undertaken.

Fig. 1 shows a very usual method for coupling the receiving circuit with the antenna. The adjustable condenser C_1, made use of only under certain circumstances, allows of tuning in the receiving circuit, and is generally very much smaller than the block condenser, C, used as shunt to the telephone, T. If C is increased while the messages are being received, the intensity in the telephone increases at first, followed by a deadening and lowering of the note, due, one might imagine, to the suppression of the higher harmonics. As the condenser, C, and the inductance of the telephone form an oscillatory circuit, it is reasonable to expect resonance with some

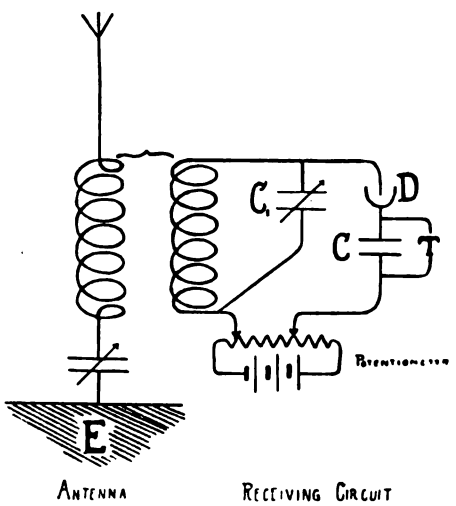

Fig. 1

of the harmonics. If this be so, the best value of the capacity, C, will be when the telephone circuit is in resonance with the more pronounced of these harmonics. Moreover, the addition of an inductionless resistance, if of sufficient value, to the telephone circuit should effectually prevent all resonance, and no rise in intensity in the telephone would be observed.

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Experimenting with the arrangement shown in Fig. 2, I have found this actually to be the case; indeed, with one telephone tested, whose resistance was large compared with its inductance (2,000 ohms and 0·02 henry respectively), there was a continuous falling-off in intensity from the moment condenser C was put across it without any further addition of resistance.

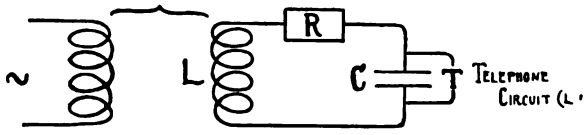

Fig. 2

The current through the telephone is, of course, intermittent, occurring every time the detector, D is traversed by oscillations picked up from the antenna. We may, however, regard it as an alternating current whose frequency is that of the break in the primary current at the sending station, and which has superposed on it a direct current, and contains in it also a large number of harmonics.

The following arrangement was adopted as sufficiently well reproducing the condition of things in the receiving circuit: L represents the inductance of the receiving circuit. The seat of the E.M.F., as before, is the circuit LC, but is produced by coupling with an alternating current instead of being taken from a potentiometer.

With such an arrangement as this the current due to any particular harmonic through the telephone is a maximum when

$$C = \frac{L}{R^2 + \omega^2 L^2} + \frac{L}{R_1^2 + \omega^2 L_1^2}$$

where L and R are the inductance and resistance of the coupling circuit LC, L_1 and R_1 the inductance and resistance of telephone circuit, consisting of the telephone and the condenser, C, and $\omega = 2\pi$ X frequency of the harmonic.

When R_1 is very large and R small, very beautiful resonance in the coupling circuit, with the harmonics in the alternating supply, is obtained. The intensity of the sound in the telephone is a series of maxima, each maximum giving a different note, whose frequency is the same as the harmonic. In the case of wireless telegraphy, the resistance R is in general greatly due to the detector, and from the symmetry of the expression given for the value of C, if R_1 were small this time, we should expect to have the same phenomena in the telephone. R_1, however, is not small, and, instead of hearing several notes at different maxima, the intensity rises to one maximum only, not very sharply defined.

With three different telephones the following results were obtained:

TABLE I.

Telephone's Resistance.	Telephone's Inductance.	Value of Capacity to Produce Maximum.	Frequency of Telephone Circuit.
Ohms.	Millihenries	Microfarads	
3·75	4	4·5	1,190
130	48	0·3	1,340
157	100	0·2	1,130

We see from this that when the maximum occurs the frequency of the telephone circuit is very approximately the same for very different telephones. No very good agreement can be expected, as not only is the inductance of a telephone difficult to measure accurately, owing to its resistance, but the optimum value of the capacity is not very easy to note. The constants of the coupling circuit, LC, were L = 158 millihenries and R = 4,000 ohms.

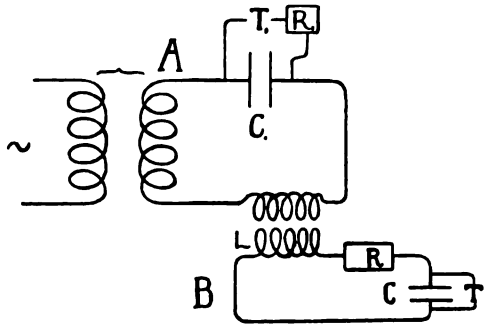

Fig. 3

To study better the effects of resonance in the telephone circuit, the following arrangement was adopted:

Circuit A is brought into resonance with

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any desired harmonic by varying C_1 and listening in the telephone T_1 (R_1 must be large—say, 10,000 ohms) till the corresponding note is a maximum. Circuit B is now coupled with A and C, varied till the harmonic gives a maximum in the telephone T. In this way the following results were obtained:

TABLE II.

Harmonic.	Frequency of Harmonic.	Telephone's Resistance.	Telephone's Inductance.	Value of Capacity to Give Maximum.	Frequency of Telephone Circuit.
			mlh.	mfd.	
3rd	240	157	100	1 (appx)	437
15th	1,200	3·75	4	4·5	1,190
—	—	130	48	0·35	1,230
—	—	157	100	0·2	1,130

The discrepancy between the frequency of the harmonic and that of the telephone circuit (calculated by taking into account its resistance which is effective in low frequencies) in the first case is very great. It is due partly to the fact that it was very difficult to decide when the maximum occurred, but chiefly to the existence of the higher harmonics, as the fifth and seventh, which were still quite strong. To separate mentally the effect of each note was impossible.

In the case of the other telephones I was unable to determine the optimum capacity at all, the change in intensity was so imperceptible, but for the small inductance telephone it was certainly greater than 12 microfarads. With the 15th harmonic it was different, as it was very much more powerful than any of its neighbours when separated in the way given above, and fair agreement between its frequency and that of the telephone circuit was obtained.

It would appear, then, that when a telephone is shunted with a condenser, the maximum intensity in the sound which occurs is due to resonance in the telephone circuit with the various harmonics, the maximum being in reality a compromise of several maxima due to several harmonics. In the case worked out above it occurred in the region of the maximum produced by the 15th harmonic, which was a particularly prominent one.

Applying these results to the case of the telephone used as a receiver in wireless telegraphy, we see that the value of the capacity used as a shunt to the telephone, which produces the maximum intensity in the telephone, is not independent of the break in the primary current at the sending station; that in the general case, where circuits in parallel with the telephone have a large resistance, this maximum is due to resonance in the telephone circuit alone; that the "harmonics" in the break, and not the frequency of the break itself, may be the most important factor in determining the value of the capacity to produce the best effect for any one telephone.

THE CALIBRATION OF WAVE-METERS FOR WIRELESS TELEGRAPHY.—The main source of error or uncertainty in the calculation of the frequency of a wave-meter lies in the capacity between neighbouring portions of the coil forming the inductance. With the condenser removed the coil itself has a definite natural frequency, the ends acting as the plates of a condenser, and the central portion as an inductance. Knowing the effective inductance and the natural frequency, the effective or self-capacity of the coil is calculable. Professor G. W. O. Howe, in a paper before the Physical Society, asks in what way the calculation of frequency for a capacity inductance combination must be modified in order to allow for the self-capacity effect of the coil. No attempt is made to give an exact answer to the question, but it is shown that for practical purposes it is sufficient to take the effective inductance as equal to the total inductance and add the self-capacity, calculated from the natural frequency on this assumption, to the capacity of the variable condenser. An experiment was made on the coil having an inductance of 2·16 millihenries, and a natural wave-length, when freely oscillating in space, of 185·5 m. Its terminal capacity was increased by small amounts by means of brass spheres varying distances apart, and the resonant frequency determined in each case. Plotting the square of the wave-length against the added capacity, a straight line is obtained which does not pass through the origin for zero added capacity. The result shows that the effect of self-capacity of the coil is to add a constant capacity of 5·5 micro-mfd. to that of the variable condenser.

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SCIENTIFIC NOTES

ATMOSPHERIC DISTURBANCES. — Dr. H. Mosler deals at length, in the *Electrotechnische Zeitschrift*, with the problem of atmospheric disturbances in wireless telegraphy. The investigations were carried out between August, 1911, and July, 1912, and these enabled Dr. Mosler to collect some useful data as to the occurrence of disturbances in different seasons, throughout day and night, and under varied atmospheric conditions. The results are set out in tabular form. On January 25th, 1912, there were no disturbances between the hours of 9 a.m. and 8 p.m. At 9.30 p.m. the disturbances averaged 0·25 per minute, at 11 p.m. 1·5, at 12.15 a.m. (January 26th) 1·7, at 3 a.m. 1.

The following data were collected on July 24th and 25th, 1912:

Time.	Number of Disturbances per Minute.	Weather Conditions.
10.45 a.m.	1	Storm approaching
12.15 p.m.	9	Stormy
12.45 ,,	20	Lead-grey clouds pass over aerial wire
1.20 ,,	20	Sultry
2.00 ,,	27	Clouds increase
2.20 ,,	43	Thunderstorm approaching
2.45 ,,	48	Thunderstorm approaching
4.00 ,,	53	Thunder feebly audible
5.00 ,,	50	Thunderstorm in S. & S.E.
6.00 ,,	47	Thunderstorm in S. & S.E.
7.45 ,,	52	Clouds over antenna
8.00 ,,	52	Clouds over antenna
9.15 ,,	48	Thunderstorm passes in south-westerly direction
11.00 ,,	40	Clearing up over station
11.45 ,,	28	Partly starry, still clearing up
1.00 a.m.	15	Predominantly starry
2.30 ,,	9	Starry
6.30 ,,	4	Cloudless
8.00 ,,	5	Cloudless

The character of the clouds and the temperature of the air were of importance, and it was noticed that the frequency of the disturbances increased as lead-grey storm clouds hovered over the antenna and decreased after those clouds had passed. Dr. Mosler has found that the disturbances caused by lightning discharges have no influence upon receiving stations situated some distance away from the seat of the discharge. Atmospheric disturbances are more frequent in mountainous country which favours the formation of clouds and thus tends to produce greater potential falls than in flat country. Disturbances increased during hail and snow storms in winter, whilst they were relatively infrequent when the sky was overcast or during rain or fog.

* * *

MEASUREMENT OF THE FREQUENCY AND DECREMENT OF COUPLED CIRCUITS.—In a paper read before the Société Française de Physique, C. Tissot refers to the well-known fact that four sets of oscillations exist in a coupled system, due to the reaction of the two circuits on one another. The four oscillations may be divided into two groups of different periods. The inductive effects on the wave-meter are additive for one group and subtractive for the other. In order to measure with some precision the periods and decrements of the oscillations in the whole system, it is desirable to separate the two resonance curves of the two secondary oscillations. This may be done as shown by Zenneck in *Leitfaden. d. drahtlosen Telegraphie.* The author establishes the method mathematically at some length, and then describes a special type of wave-meter due to Pellin. The inductance of this instrument consists of a circular solenoid, which is thus unaffected by any inductive influence from the circuit to be measured. Two coupling loops—necessary for the Zenneck method—are connected to the inductance by flexible wires. The variable condenser plates are of lozenge shape, and slide over one another in such a way that the capacity is a linear function of their relative displacement. The scale of the condenser is directly graduated linearly in wave-lengths. To measure the two wave-lengths in a transmitter the proceeding is the following: One of the coupling loops is brought near the Oudin resonator forming the transmitter, and the condenser varied until maximum reading is indicated. This gives the wave-length λ''—the long wave. The second coupling loop is now brought near the Oudin, the reading now either

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increasing or decreasing. The loop is withdrawn until the reading passes through a minimum. The reading can then by suitable arrangement of the first loop be made zero; with the coupling loops then fixed, the procedure to measure λ' is that usually employed. Similar manipulation enables λ'' to be fixed. The method described for obtaining the decrement is to read the current for resonance, and then put the wave-meter out of tune until the current I_o is reduced to $I_3/\sqrt{(2)}$; then

$$\gamma+\delta=\pi(\lambda''-\lambda')/\lambda_o,$$

where λ_o is the wave-length for resonance and λ'' and λ' the out-of-tune readings each side of the resonant position; γ is the decrement of the transmitter, and that of the wave-meter. With the type of wave-meter described the difference $(\lambda''-\lambda')$ and λ_o are read directly. By using an arc instead of a spark in the exciting circuit, the decrement of the wave-meter is at once obtained from the equation above.

* * *

RESONANCE IN WIRELESS TELEGRAPHY.—In a paper of such interest that we await a sequel on the same lines, Dr. W. H. Eccles first sketches, in the *Electrician*, the various steps which have been taken from time to time in the direction of exalted resonance in wireless work, and then goes on to a mathematical comparison of the different kinds of waves produced by the various methods adopted, in so far as they are involved in one particular part of the process of transmission and reception. The particular part in question is the transfer of energy from the transmitting aerial to the receiving aerial, and Dr. Eccles deals with the question by calculating what he calls the "efficiency of transmission" for the various kinds of wave-trains; that is, the ratio of the energy picked up by the receiving aerial to the energy radiated by the transmitting aerial.

He deals first with the original Marconi aerial with the spark-gap in series—the "plain aerial" of early days, whose characteristics he sums up tersely by saying that it "possessed radiating powers so far in excess of its capability of storing energy that the train of waves emitted by it was comparatively short."

This aerial, together with the Lodge arrangement with its large elevated capacities, he shows to have the percentage efficiency represented approximately by

$$100b/(b+m)$$

where b is the co-efficient of decay of the receiving aerial, and where m is the co-efficient of decay of the transmitting aerial. This percentage represents the percentage of the *ideal* efficiency which would be given by entirely undamped waves *of pure sine-shape.*

In the case of the "plain aerial," m was probably much larger than b, and might be put as equal to $3b$, giving a percentage value of 25 per cent.

The Lodge conical capacity areas, having greater storing capacity and less radiating power, would probably give a value of m about equal to b, so that their efficiency might be 50 per cent.

Dr. Eccles proceeds to point out that the loose-coupled sender using ordinary sparks may, so far as this investigation is concerned, be considered along with the "quenched spark" and the Marconi disc spark, and shows that its efficiency may be represented approximately by the percentage

$$\frac{100b\,(b+m+n)}{(b+m)\,(b+n)}$$

b having its former meaning, and m and n being the co-efficients of decay of the two waves emitted by the transmitting aerial.

Then, taking two actual examples of spark-stations, he shows that the values of m $(=\cdot02)$ and n $(=\cdot2)$ found at one of these stations give an efficiency of 90 per cent., and at the other station the values ($\cdot05$ and $\cdot1$ respectively) give an efficiency of 92 per cent. And this is so even when a decrement so low as $\cdot05$ per half-period has been assumed at the receiving aerial, so as to favour the continuous wave method as much as possible.

The conclusion, therefore, arrived at is that so far, at any rate, as this part of the process is concerned, the Spark Systems have already arrived so near to the ideal efficiency of 100 per cent. (which could only be attained by perfectly continuous waves of perfect sine-shape) that a generator of continuous waves would have to have high efficiency "inside the station" in order to prove more economical.

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Signalling throughout the Ages

From Æschylus to Marconi

NEARLY every train that comes into Charing Cross waits a considerable time on the bridge outside before entering the station. No doubt this is very annoying to the vexed soul who thinks he can't afford to waste a minute, but to the passenger who is not above indulging in a day-dream this is an opportunity not to be missed. Before him is spread out the whole splendid sweep of the Embankment, showing white against the shifting foliage of the plane trees and crowned with serried ranks of twentieth-century palaces. Aladdin palaces they are too, erected some to Business, some to Pleasure, but all as magnificent as each other. To the left the Houses of Parliament, and more particularly the beautiful St. Margaret's Tower, command the view, while to the right the eye catches the masts and aerials of the wireless installation over Marconi House silhouetted sharply against the sky. Here, then, is the allegory. Before you, towering over the murky Thames, is the splendid embodiment of Imperial power. This Gothic magnificence is the shrine of our national life, alone supplying the motive force for the nations—nay, more than that, for the world's progress. Within, the keenest intellects of the Empire take counsel together. Together they watch the ebb and flow of human affairs. Before them are placed the manifold needs of the times, and it is for them to solve the bewildering tangle of political and social economy. As a matter of fact, these, the nation's representatives, are alone in a position to attempt such a task, for it is their unique privilege to hold in their hands the myriad threads of government. Like skilful weavers, they weave these multiple interests into an ordered pattern, their whole aim being to produce unity of purpose—that most important factor in all government, and the only power likely to have any permanent effect on the progress of the nation.

But if the Houses of Parliament represent the Lawgiver, the Marconi installation represents the Prophet. It is the forerunner of twentieth-century science, opening up a new horizon of knowledge and a new vista to mankind. It has a prophetic, a still small voice :

> Which whispers in its song
> Where hast thou stayed so long ?

" I," it urges, " I am the great electric force of Nature. Age after age my power has lain latent, and men have passed it by unheeding. Now that power is manifest, but its capabilities not yet fully fathomed. It is for you, the people of the New Age, to conquer new worlds, worlds as yet undreamt of by man. Advance, be tireless, learn, strive, wrestle with secretive Nature, and it may be that I shall some day be your swift, silent messenger over the great wilderness of . . . "

But Pegasus must be bridled, and we must not allow our day-dreams to leap too far beyond the matter-of-fact. Nevertheless, whatever may be the opinion of the merely matter-of-fact, the slender Marconi masts and almost invisible wires do typify a new power : power over the elements and forces of Nature whereby one of its most elusive entities has at last been yoked to the service of man. This also is progress, but progress in the natural world, as contrasted with the world of human affairs ; and if the Houses of Parliament stand as a symbol for human advancement, so also does a wireless installation mark an epoch as bringing another factor into the complex system of the universe.

But talking of progress throws the

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thoughts back to a more primitive existence, and as the subject of wireless has been brought to our notice, let us imagine the world when the present means of communicating through space was wanting. What a darkness, what a narrowing of outlook, creeps over the intelligence! What loneliness must have encompassed the savage, who could only communicate with those in his immediate presence! Life must have been full of the terrors of unknown quantities for him, all of which were enhanced by the powerlessness to combine with his fellows in subjugating the overwhelming forces of Nature.

Aes triplex, again, must have fortified the hearts of the early mariners who put out to sea knowing that if danger overtook them they would appeal for help in vain, as there was no messenger who could carry their cry of distress to their unsuspecting fellows on shore. Think, too, what it meant to travel from city to city. As soon as your comrades were out of sight you were alone, travelling in a new world, surrounded with enemies, and with nothing but your personal force to protect you from a thousand foes.

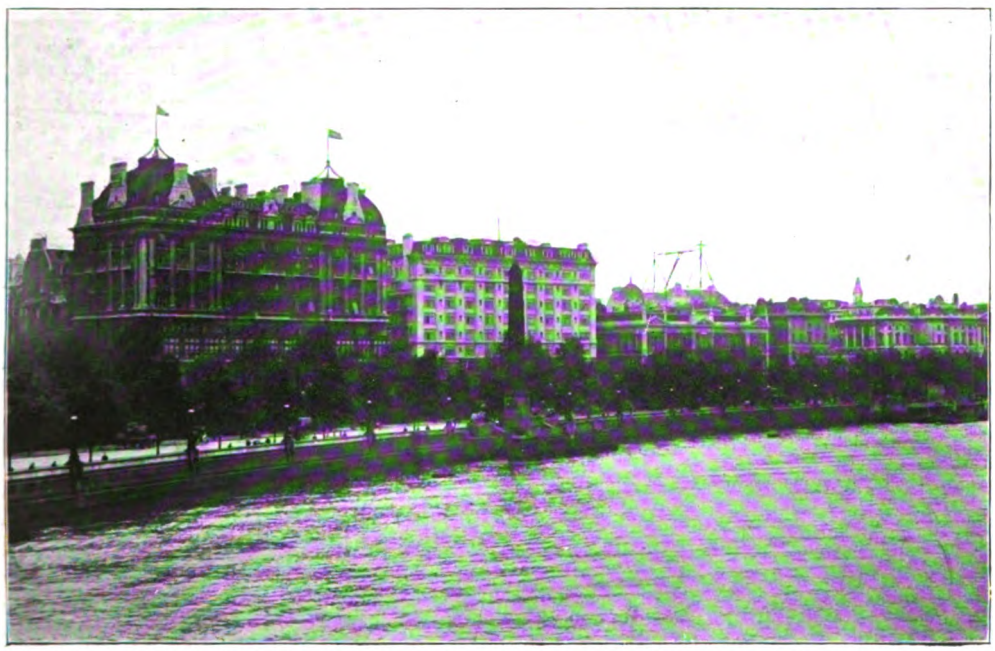
Necessity, however, is the mother of invention, and no doubt it was the ever-present menace to life which compelled man to devise some process of signalling. Naturally fire would commend itself as an expedient for such a purpose, and so we find it in use amongst the primitive civilisations, and more especially the Greeks.

We call to mind a passage in the "Agamemnon" of Æschylus in which such an episode occurs. It opens the play. The watchman is standing on the Towers of Argos:

> Watching for the torch,
> The appointed flame that wings a voice from Troy,
> Telling of Capture.

Suddenly the flame grows bright, and news is sent to Clytemnestra that the weary siege is over and Troy has fallen. The news spreads through the city, and the chorus:

> Old Troy is taken? how?—when did it fall?



Looking east from Charing Cross, this view shows the wide sweep of the Embankment. To the right of the large building on the left can be distinguished the aerials on the roof of Marconi House.

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And Clytemnestra replies:

The self-same night that mothers this to-day.

While to the question

But how? what stalwart herald ran so fleetly?

she answers:

Hephæstus. He from Ida shot the spark;
And flaming straightway leapt the courier fire
From height to height; then the Hermæan rock
Of Lemnos, first from Ida; from the isle
The Athoan steep of mighty Jove received
The beaming beacon; thence the forward strength
Of the far-travelling lamp strove gallantly
Athwart the broad sea's back. The flaming pine
Rayed out a golden glory like the sun,
And winged the message to Macistus' watch-tower.
There the wise watchman, guiltless of delay,
Lent to the sleepless courier further speed;
And the Messapian station hailed the torch
Far-beaming o'er the floods of the Euripus.
There the grey heath lit the responsive fire,
Speeding the portioned message; waxing strong,
And nothing dulled across Asopus' plain
The flame swift darted like the twinkling moon,
And on Cithæron's rocky heights awaked,
A new receiver of the wandering light.
The far-sent ray, by the faithful watch not spurned,
With bright addition journeying, bounded o'er
Gorgopus' lake and Ægiplanctus' mount,
Weaving the chain unbroken. Hence it spread
Not scant in strength, a mighty beard of flame,
Flaring across the headlands that look down
On the Saronic gulf. Speeding its march,
It reached the neighbour-station of our city,
Arachne's rocky steep; and thence the halls
Of the Atridæ recognised the signal,
Light not unfathered by Ida an fire.
Such the bright train of my torch-bearing heralds,
Each from the other fired with happy news,
And last and first was victor in the race.
Such the fair tidings that my lord hath sent,
A sign that Troy hath fallen.

But fire was not the only means of signalling which the Greeks employed. They had a system of heliography, employing their burnished shields much in the same way as the heliograph flashes a message to-day—or perhaps it would be wisest, considering the use now made of wireless telegraphy in the Army, to say yesterday. This, you see, was a great advance on beacon signalling. But its limitations are obvious. The distance was limited to the range of human sight, and it was only when the telescope was invented that the distance could be materially increased. Another invention which afforded a new means of signalling was that of gunpowder. Its discovery may be safely ascribed to the fourteenth century, though its use for signalling was not recognised till much later. In fact, one of its earliest mentions in this connection is in the instructions issued by Dom Martin de Padella to his fleet in 1597. From this time onward to the invention of the telegraph, a period of several centuries, was unmarked by any striking development. Systems were improved and codification elaborated, but as yet there was no Morse code and no telegraph.

Signalling by means of flags was, of course, largely used, but the most interesting of all message transmission was that employed in the days of Nelson by the British Government. It was the semaphore system, by which messages were signalled without any intervention from Whitehall to the quarter-decks at Portsmouth and Plymouth. The initial station was installed in Whitehall, where wireless has now been erected, and consisted of a simple shutter apparatus raised some height from the ground. At convenient eminences along the road similar contrivances were placed, and these were in use sufficiently late in the nineteenth century for the late Professor Skeat to remember such a semaphore signal on One Tree Hill.

There were fourteen stations in the Admiralty chain between London and Portsmouth, including Whitehall, Chelsea and Putney, within the Metropolis. Eight of the stations did service for the line to Plymouth. Another line of nineteen stations connected Whitehall with Yarmouth, and a fourth, comprising ten stations, ran to Deal. The average distance between two stations was eight miles, but some were as much as fourteen miles apart. Each station was in charge of a naval lieutenant, who had three or four men under him. One man received signals through the telescope, another worked the winch, the third observed the receipt of the signal at the next station, and the fourth entered the record in a journal.

THE OPTICAL TELEGRAPH.

This system of practical telegraph was invented by Claude Chappe in 1796.

Chappe, who was born at Brûlon in Sarthe in 1763, managed to produce this

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system of optical telegraph at a very opportune moment, for France was then in the throes of revolution, with powerful enemies menacing her at every side. Frenchmen were quick to recognise the advantages of the arrangement, and when Chappe brought his invention before the notice of the National Assembly it was immediately adopted by the French Government, and Chappe himself appointed *Ingénieur-Télégraphe*. Unfortunately the invention brought little peace of mind to the inventor, for the malicious criticisms of envious rivals and their endeavours to throw doubt on his claims to be the originator of the system caused him such profound depression that he committed suicide in 1805.

It was from France that the semaphore was introduced into England, Lord George Murray, afterwards Bishop of St. David's, being responsible for its adoption here, and for a time managing the new telegraphs at various ports and on Wimbledon Common.

For nearly fifty years on the roof of the Admiralty this quaint telegraph station could be seen. It consisted of a wooden structure, from which a large telescope protruded, while above was hung a series of six movable shutters. It was one of the sights which Londoners pointed out to the wondering admiration of their country cousins, and it was considered by Leigh Hunt worthy of mention in his writings, for in the pages relating to the execution of Charles I. he remarked that on the roof, whence Archbishop Usher viewed the royal tragedy, "telegraphs now apply their dumb and far-seen discourses like spirits in the guise of mechanism, and tell news of the spread of liberty and knowledge all over the world."

THE MORNING WALK.

The *atra cura* of the system was fog; in fact, the whole arrangement entirely depended on fair weather, for even a rising mist would effectively obscure the signals. It is curious, therefore, to read that "the tranquility of the morning and evening are ascertained to be the most favourable hours for observation," and such a report must surely refer to weather conditions which prevail considerably after sunrise and before sunset on a fine summer day. Think of the autumn mists, the November fogs, and the general murkiness of January, February and March. There can have been little opportunity for using the telegraph in any of these months. The authority who made the foregoing observation is Sir Richard Phillips, and it occurs in his "Morning's Walk from London to Kew."

Sir Richard was a most interesting character of the late eighteenth century. Antiquarian, scientist, classicist—encyclopædist, we might almost say. He belonged to a class of men who were not uncommon in his day, and there was no subject of which he was entirely ignorant, and equally there was no subject of which he was entirely master. Brought up to the trade of a brewer, he quickly tired of this unenlightening occupation, and on his own accord became usher to a school in Cheshire. Afterwards he borrowed capital and opened a hosiery establishment, and later added the trades of stationer, bookseller, and patent medicine vendor to his early venture. He wrote considerably, but it is as author of the foregoing book that he shines in his zenith. He discusses everything that may take his fancy from the fashions of the times to the philosophy of Pythagoras, and naturally he could not pass the semaphore station at the Admiralty without having a good deal to say on the subject, thereby giving us some of the most interesting pages in his scrap-book. He tells us that the operators calculated on about 200 days in the year on which signals could be transmitted, while on about 30 more the signals could be worked for a few hours (surely a somewhat optimistic calculation, or times are woefully changed).

Dead flats were found to be generally unfavourable, and stations were useless nearly in the proportion of the miles of dead flat looked over. On the contrary, stations between hill and hill, looking across a valley or series of valleys, were most clear, and water surfaces were found to produce fewer obscure days than land in any situation.

A POLITICAL ECHO.

William Cobbett, the famous editor of *The Political Register* and ardent supporter of Queen Caroline, was a man of similar genius to Phillips, and he hit upon much the same idea for employing his general knowledge. In 1821 he traversed England

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on horseback, picking up information which he embodied in articles for his paper. These were afterwards collected and published under the title of "Rural Rides." Here he mentions that the hour of 1 by Greenwich time was transmitted to Portsmouth and back in 45 seconds, the distance being altogether 170 miles; while a similar signal between Liverpool and Holyhead, a distance of 144 miles, is stated to have been frequently sent and answered in half a minute. But this must have been under exceptionally favourable atmospheric conditions, and the message was obviously a simple one. It was a very different matter when an unusual message had to be spelled out or observation was impeded.

Walford, a major in the Essex Militia, who published a book on "Old and New London," puts down the time taken in sending a message from London to Portsmouth on fine days to be about an hour, and this is probably much nearer the mark.

Messages of a stereotyped character were embodied in special short signals, and there is no doubt that these were often sent with wonderful celerity. For example, "Sail to the northward by the first fair wind" was a message for which one signal was provided. Another was an order to execute the sentence of a court-martial: that signal travelled with deadly speed. Special arrangements of the signals indicated the proper destination of the message, whether it was intended for the Port Admiral at Portsmouth or for the Port Admiral at Plymouth, or for the Commander of the Channel Fleet, etc. In all 63 separate signal arrangements were used, and the handymen on tower and hill top knew how to make them talk.

FROM SEMAPHORE TO WIRELESS.

We have a relic of this semaphore system in the signals used on railways. Their simple and effective working, combined with the fact that the messages they have to deliver are of extreme simplicity—merely a matter of "pass" or "stop"—renders them sufficient for their purpose. But when the messages were of varying purport, the method of transmission must have been tedious in the extreme. What a revolution, then, must have been effected by the invention of the electric telegraph! And when on December 31st, 1847, the last manual signal passed between London and Portsmouth, and the telescopes were removed and the quaint wooden structures dismantled, it was verily a new day that had dawned for inter-communication. Man was then communicate with man over vast stretches of country in the least possible time. Even the new system had its drawbacks; it entailed a vast network of wires and cables and elaborate machinery.

But the day of wireless telegraphy was at hand. Already Faraday, Clerk Maxwell and Hertz had prepared the way by their researches for the ultimate development and practical application of their theories by Mr. Marconi, and it was a great day for England when, in 1896, he took out his first patent for wireless telegraphy, and introduced his apparatus to the Government.

The splendour of such an achievement cannot be overestimated. It was a flash of genius—and more than genius—that took the very forces of the invisible and used them as man's second speech. It is the simplicity of the scheme which makes it the more magnificent, and brings it nearer to the sublime, for Nature is always simple in her workings, though the effects may be complex. This is a doctrine which cannot be overlooked. On it will be based the ideal state, the Eutopia towards which all enthusiasm looks forward. As the world advances, so its organisation will become simpler, so the complexities will be lessened, or rather what now appear complexities will be welded together, and things at present diverse will be found to be the counterpart one of the other, fitting into the scheme of the universe as the threads in the weaver's loom.

Every day invention and research, and the less recognised branches of knowledge—philosophy and art—are advancing this annealing process, and every effort in this direction deserves the encouragement of all mankind. Therefore it is worth while to wait a moment, even if it be in a train on Charing Cross bridge, and remember the splendid work being carried on in our "Palace of Westminster"; then, not forgetting the discoveries and inventions that have made that work possible—and of these wireless telegraphy is not the least—let us be thankful for the age we live in.

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A Few Marconi Reminiscences

Interesting Early Experiments

By A. E. HANSCOMB

IT was in the spring of 1898, towards the end of February, that I first met Mr. Marconi. He had been conducting his earliest experiments from the cliffs at Totland Bay to a small steamboat, the *Lymington*, if I remember rightly, anchored a short distance from the shore, and at the time named he had established himself in a villa on the south cliff at Bournemouth, quite close to the pier. From here he was sending to and receiving messages from the Isle of Wight, thirteen miles distant on the east, and Swanage, with the Purbeck Hills intervening, eight miles distant, across the bay, on the west. "Adversity makes strange bedfellows," and so it was that a public misfortune brought us together. Mr. Gladstone, shortly before his death, spent nearly a month in Bournemouth. On the day of his arrival a heavy snowstorm visited the Evergreen Valley, and all the wires—telegraph and telephone—were "down," so that our Press telegrams announcing the arrival of the great statesman had to be sent by train to Southampton to be dispatched thence to London.

AN EARLY TRIUMPH.

On the morning following Mr. Gladstone's arrival I paid Mr. Marconi a visit at the little room which he occupied near the pier, and informed him that Bournemouth, for the first time in its history, was practically isolated from the outside world as far as any "wires" were concerned. I remarked: "This is where you come in, I suppose?" He smiled, and modestly replied: "We'll see what we can do." He then retired behind a screen, and I heard a few moments' "clicking" on his transmitter. He was inquiring of his assistant in the Isle of Wight what sort of weather they were having at Totland Bay. In a few moments he handed me a reply message, stating that the weather was "cold but fine." At the same time he remarked: "I am glad to have been able to demonstrate in so unexpected a manner the superiority of my form of telegraphy. You see, I am independent of fog and snow or any of the other elements which go to make the English weather." It was indeed one of the first illustrations of the triumph of "wireless" in its early stages.

It was fifteen years afterwards, in February, 1913, that I next met Mr. Marconi. It was in the corridor of the House of Commons on a Marconi Committee day. The enthusiastic, unknown, modest young man had become an outstanding figure of world-wide fame—a man who had girdled the earth with his "system," and had given his name to a scheme of communication calculated to revolutionise the world's affairs.

When visiting the Lizard district some years ago I was conversing with the lighthouse keeper, who told me of a remarkable instance, even in those early days, of the usefulness of the wireless system. He had received a message, through the adjacent Lloyd's station, from a fog-bound ship some distance out to sea, stating that the captain believed himself to be in the neighbourhood of the Lizard, and asking that if the message was "received" the powerful foghorns might be "blown." The request was complied with, and shortly afterwards a big German liner was seen making its way shorewards, and thereafter proceeded up Channel. The captain, on arrival at Southampton, acknowledged the kindly response to his "wireless" by a letter to the lighthouse keeper. He explained that he had been running in a fog for nearly two days, and that the wireless installation had probably saved him from disaster—at any rate, it enabled him to complete his voyage in safety and good time.

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Some amusing personal reminiscences come to my mind as I write. I was on one occasion visiting on holiday a certain Cornish coast resort, and strolled out on a summer's evening to a wireless station. There were two men in charge. With instinctive journalistic curiosity, I was asking as to the height of the "pole" and other innocent questions of one of the men, when his companion looked out from behind a screen, and in a peremptory manner said: "Mr. Walker, please don't answer any more questions." I was evidently regarded as a "spy" or some equally dangerous person.

A "VERY SICK" JOKER.

On another occasion, of more recent date, I was one of a number of journalists on a pleasure trip out from Harwich. We were sending wireless messages to friends in London from the packet boat. One of the party conceived the brilliant idea of sending his wife a few words saying he was "very sick," but hoped to be home as usual in the evening! He laughed hilariously at his idea. I saw my friend that night in Fleet Street and asked him whether his message reached "home." It did, and he had had a rough time with his better half. He was not laughing. His good soul of a wife on receiving the mysterious message, with no reference to locality, had hastened up to his office in London from the suburbs "fearing the worst," as she said. He got such a "wigging," as he told me afterwards, that he was never likely to indulge again in such a practical joke. In fact, he agreed with his wife that it was a senseless form of amusement.

Much water has flowed under London Bridge since those days; a great deal of progress has been made in wireless telegraphy and its adaptability to modern needs. We have seen how it has annihilated space, how it has saved thousands of lives, how it has tracked criminals, how it has aided commerce and social intercourse, how it has succoured those in distress who "go down to the sea in ships." "Marconigram" has indeed been "adopted" into the English language, and in course of time will doubtless take its place in Walker or Webster or Nuttall with becoming distinction.

IN A STUDIO

PHOTOGRAPHY never yet has produced the speaking likeness. Undoubtedly it will represent for us the features of our friends with some degree of verisimilitude. But that photography can do more than this, even the most enthusiastic photographer, if he honestly takes himself to task and weighs the pros and cons of the case, will hardly be inclined to admit. This accounts, no doubt, for the great popularity of those silver-grey effects which are much in vogue at the present moment, and show the subject of the photograph in a kind of misty twilight. It cannot be said that such photographs make any attempt at portrayal; nevertheless the artistic setting gives that charm to the figure or the landscape, as the case may be, which is much nearer the truth than any actual definition could possibly attain.

There is at least one little oasis in this busy London—15-16 The Railway Approach, E.C.—where the truth of our contention can be amply demonstrated. Here are delightful portraits, sufficient to convince anyone that etching and pencil sketches in portraiture cannot be superseded by photography. Mr. G. B. Black is the artist, and he has inherited his talent from his father, while the walls of his studio are covered with some of the most beautiful examples of the art that it has ever been the lot of the writer to hap on. It is besides quite a gallery of celebrities. But the style of the work is its chief charm. This we can discover by looking at the table on which lies "the stone" bearing Mr. Black's latest work. It is the portrait of Mr. Marconi, which has been taken from the life, and is a triumph of skilled workmanship and artistic perception.

The forceful character of the face is life-like, and the sense of fidelity arresting. Furthermore, the arrangement of the subject is all that can be desired. The head shows up clearly against the shaded background, while the chiaroscuro is treated in masterly fashion. We must congratulate Mr. Black on his happy idea and its still happier realisation of securing this authentic portrait of Mr. Marconi. We feel sure it will make a notable addition to his gallery of notabilities.

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The Pleasure Pilgrims

A Story of Several Freaks, and one in Particular

HARRY STENHOUSE had been made aware, by the novels which he read while waiting for briefs, that people sometimes died and left fortunes unexpectedly to worthy and indigent relatives. Such events were, however, so delightful and so proper that he believed them to be confined to the world of fiction. When the identical thing occurred to himself he treated it as a joke, which was none the worse for having a substantial foundation. It seemed really funny that an uncle whom he had never met should have been good enough to go out to the Argentine, speculate successfully in land, and then die with no heirs in the wide world except a young barrister in the Middle Temple.

"I can't even write to thank the old boy," he complained to the friends who congratulated him.

However, the money was serious enough—thirty thousand pounds in securities which he could convert into sovereigns any day he pleased. To tell the truth, he was slightly annoyed with his good fortune. He had planned to make his way by talent alone; he had measured his budding powers against the full-flowered achievements of King's Counsel and judges, and he was confident about his future. Now he knew that briefs would come quickly, and that fees would grow bigger, simply because he had no need of them. He would be a success not because he could rise with his own strength, but because Nunky had made pots of money in Argentine land.

It was a humiliating thought. "If I am not careful," he said to himself, "I shall become a politician or a guinea-pig—or both. I must get right away from everything and think the situation over. Shall I disappear into Labrador, like that fellow in H. G. Wells's story? I think not. He had a wife to make him cosy and listen while he yarned away like a lay bishop. Africa is no good; it is full of cinematographs and lady travellers. Even Tibet is *passé*."

The difficulty which wealth had thrust upon him was eventually solved by the creator and servant of wealth—an advertisement. He read an announcement that the s.s. *Sobrina*, a palatial vessel of 6,600 tons, decorated by Waring & Gillow, and fitted with watertight bulkheads and wireless telegraphy, was about to sail from Southampton on a pleasure pilgrimage round the world.

IN THE BAY.

The cheque which he paid for a stateroom on the bridge deck was the first which gave him a taste of the real joys of spending money.

During the first day out from Southampton very few of the passengers lived up to their expectations of a pleasure pilgrimage. The *Sobrina* persisted in washing herself elephant fashion, by the simple process of taking in water by her nose and spraying herself as far back as her tail. At the same time she rolled as if to show how far she could go without turning turtle. Harry had the spacious bridge deck to himself, and no other amusement than to watch the deck-hands dodging the waves. After an hour or two he found himself yawning and wishing he was back in Pump Court. When night came he was only too glad to join the second officer, the ship's doctor and the first engineer in a game of nap for penny points.

By the following morning, however, the emetic performances of the *Sobrina* had subsided somewhat. Up the various companion-ways sad-eyed men and women crawled, blinking at the sunshine and gazing reproachfully at the troubled sea. Harry watched them unsympathetically.

"They are all rich," he said to himself, "and they deserve it. One touch of nature

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makes them thoroughly miserable, and will do them good."

A Wordy Encounter.

His gallantry was, however, stimulated by the sight of a slim girl supporting a stout lady wrapped in a fur coat. He took the lady's other arm and assisted her to a deck chair which he had placed for himself in the most sheltered corner of the deck.

The lady drew aside the silk scarf in which her face was wrapped, and showed Harry a complexion of mottled green.

"Thank you, sir," she said, and shut her mouth firmly.

"Not at all," said Harry. "If you wait a moment I shall bring another chair for your daughter."

The lady sat up with more energy than Harry thought possible.

"Not at all, sir, if you please. My daughter can look after herself. I am obliged to you, but I wish to make it perfectly clear that I do not want anybody hanging round my daughter."

"I have no intention of hanging round your daughter——" began Harry.

"Perhaps not," snapped the lady.

"In fact," continued Harry, "I give you my word of honour not to hang round your daughter—on one condition. She must give me her word of honour not to hang round me."

He was pleased to note that his remark modified the green of the lady's complexion to a suggestion of pink. He retreated quickly, and enjoyed an additional revenge in sending a steward with another deck chair and Mr. Stenhouse's compliments.

And a Chance One.

During the day he certainly obeyed the letter of this careful mother's injunction. He did not hang around her daughter. Nevertheless he observed the girl carefully from a distance. And from his study of her graceful carriage, her delicate features, her dark hair and healthy colouring of cheeks and lips, he decided that there might be worse things than to hang round Miss Lynwood while she went round the world. He had some recollection, too, of a twinkle in her eye during his conversation with her mother.

Mother or no mother, he would take the first opportunity of renewing acquaintance with that twinkle.

The opportunity came an hour or so after dinner, when he was walking rapidly round the deck as a kind of soporific exercise. At the corner of the captain's cabin he collided with Miss Lynwood.

"Oh!" she exclaimed, and stood looking at him.

"The stars are my witnesses," he said, "that I was not hanging round you. They are also my witnesses that you rushed straight at me."

"Luckily they cannot speak."

"I suppose not. Yet there are several females among them—some of them mothers, by all accounts."

"Oh, I really must apologise for mother. She did not mean to be rude, but——"

Harry looked at her solemnly. The light showed her face clearly. He waited for the twinkle. It came as the prelude to a laugh in which he joined with enthusiasm.

"She must be sound asleep by now?" he said questioningly.

"She is," replied Miss Lynwood; "but I do not think that I ought to tell you."

"Of course not, but I am sure you are glad, for your mother's sake."

"Oh, yes. She was very ill. At first she said: 'Nessie, this boat is going to sink.' Later she said: 'Nessie, this boat is never going to sink.' You suffered from some of the after-effects this morning."

"Nessie!" repeated Harry in a whisper, as if memorising the name.

"I gave you that name, not for publication, but as a guarantee of good faith."

"Then I agree not to use it except when we are quite alone."

"Oh," replied Nessie in an altered tone, "I think we are going ahead rather fast!"

"This is a fast boat," retorted Harry. "Besides, life is short, and the art of being young and happy is long. 'Gather ye rosebuds,' and so on."

"I see that I shall have to be very stern with you," remarked Nessie.

"I bow to your decision," responded Harry solemnly.

Then they continued their promenades, but not in the contra-flow fashion. Harry took the opportunity of giving her what he called a special edition, for young ladies, of the story of his life.

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PRESSING THE ATTACK.

Next morning he made a direct attack on Mrs. Lynwood, who was looking ten years younger than she had done on the previous day—so young, in fact, that he wondered whether jealousy had anything to do with her objection to "hanging round."

"I would like you to understand," he said to her, "that the *Sobrina* is about 500 feet long and 50 feet wide. Therefore it is 500 to 50 that your daughter and I will meet accidentally several times a day. When that happens it would be rude of me to pass by as if we were not going round the world together. I am bound to ask her how she is, and talk about the weather, and how much one eats on board ship, and what a wonderful thing wireless telegraphy is, and all that."

"You are a very impertinent young man."

"I am a very determined one. And now that we understand each other, I may tell you that if the worse comes to the worst, I am comfortably rich, thoroughly sound in constitution, of irreproachable descent, and quite capable of getting a title or an under-secretaryship, or anything you think necessary."

"Well!" exclaimed Mrs. Lynwood. Then she paused in a search for words which would be at once adequate and ladylike.

"'All's well' is the nautical phrase," remarked Harry.

Nevertheless he had a very anxious time during the next day or two. Miss Lynwood seemed to have a magnetic influence on every male creature from the captain to the Marconi operator. Those who were on the right side of thirty were frozen off by Mrs. Lynwood, and those on the wrong side were daunted by being adopted by Mrs. Lynwood as her own squires. During the day which was spent ashore at Havre there was nearly civil war over deciding who was to attend Miss Lynwood (and was *not* to attend Mrs. Lynwood) on the excursions to the lighthouse and to Trouville. Similar struggles continued until the *Sobrina* reached Vigo, when an entirely new phase was brought about by the arrival of Mr. John James Sullivan.

He had come on board during the night. Rumour said that he owned several ironstone mines in Spain, and was taking his first holiday from business. He was a large man, with a roving eye and a smooth, confidential voice. After having spent a few hours in surveying the pilgrims, he fastened himself upon Mrs. Lynwood.

Obviously she liked the process. And obviously Miss Lynwood did not. She was pointedly rude to Mr. Sullivan—rude, that is to say, with the arctic politeness which only young women can assume with perfect grace and effect. The performance amused Harry, until he noted that Nessie clung to her mother while Mr. Sullivan was "hanging round"—which was generally always. This *partie carrée* ought to have been quite convenient and jolly, but as Mr. Sullivan and Mrs. Lynwood did most of the talking, while Nessie sat silent and watchful, Harry began to realise that he was becalmed in the doldrums.

SCIENCE AND MARRIAGE.

He betook himself to the Marconi cabin to think the situation over. The operator was a sapient young man, who answered readily to the name of Tommy.

"Now, Tommy," said Harry, "you have been twice across the Atlantic, and have had a lot of experience of affairs. What would you do if you could not get any reply to your signals from a young lady because she was too busy chaperoning her mother?"

"Have you tried the S O S signal?" Tommy asked.

"Oh, yes. But apparently she knows neither Morse nor remorse."

"Then you must get the mother married and settled," replied Tommy.

"You are a bright boy," commented Harry. "I wish you would marry her yourself."

"Personally," responded Tommy, "I do not think that men of science ought to marry. At any rate, I shall hardly have time for it. In another ten years Marconi and all those chaps will be thinking of retiring, and there will be a chance for fellows like me, who have been swatting up Fleming's books and thinking things over. I have my own theory about the ether."

"Well, don't divulge it prematurely."

"Trust me for that. But the ether is a queer thing, I tell you."

"So is woman, according to all accounts, though Sullivan tells me that they are as simple as cheese."

Tommy's suggestion led Harry to a con-

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fidential talk with Nessie. He met her one afternoon when both Mrs. Lynwood and Mr. Sullivan were enjoying the siesta to which the warmth of Mediterranean latitudes inclined them.

"How do you do, Miss Lynwood? I hope you have been keeping well since I saw you last."

"That was lunch-time."

"No, it was the evening we dropped anchor in Vigo Bay. Since then I have only caught far-away glimpses of you behind Mr. Sullivan's back."

Nessie was silent and thoughtful.

"Do you know," he pursued, "I have come to the conclusion that the world will never be right until your mother is married?"

"Don't talk nonsense, Mr. Stenhouse!"

"Why not?"

"Because it is cruel nonsense you are talking."

"I am sorry, genuinely sorry. But perhaps I do feel a little bitter on the subject. We were getting on famously until this suave Irishman dropped on us from the iron mines of Spain. You look troubled, Miss Lynwood."

"I am troubled, Mr. Stenhouse."

"Then let us sit down and talk it over. I can be just as sensible as anybody over a thing of this kind, if I choose."

"Can you really?"

"Try me, and see."

They sat down together under the shade of the awning.

DEAR MOTHER.

"Mother is a dear——" began Nessie.

"I am not so sure of that," protested Harry.

"Yes, she is; but she is stuffed full of the quaintest notions, and she is as simple as a child. She does not want me to get married, because it will make her seem like a dowager with no chances on her own account. She has an idea that it is a confession of failure and of old age for any woman to be a widow more than twelve months. For the last two years she has had several narrow escapes from the most impossible husbands. Oh, I never thought I could speak to anyone about such a subject!"

"Of course you did not. And you never thought you would pay me such a compliment. So that is why you give Mr. Sullivan the frozen face?"

"Oh—Mr. Sullivan! I hate him!"

"Not more than I do."

"Yes, I do. The man is a fiend. Mother is absolutely silly over his charming manners and his delightful conversation. But I notice that, although he talks about all sorts of things, and tells most amusing anecdotes, he never by any chance gives you any information about himself or his family or his business. I have asked him questions point blank, but he always evades them."

"You ought to be a lawyer, Miss Lynwood, or a private detective."

"It is no good, Mr. Stenhouse. He is too sly for me. He never lets me catch him alone for a single minute."

"Well, this is where I come in. I promise you that before we reach Colombo I will find out about Mr. Sullivan."

"Colombo! That is a long way."

"Yes, but Sullivan is a long proposition. Besides, there is a condition attached to my promise."

"Then I refuse to consider it."

"But you must consider it. It is just that you stop giving the frozen face to me as well as to Mr. Sullivan. I am getting tired of it. Any time within the last week I have been ready to leave the boat. You do not seem to understand that I have made a careful survey of this vessel, and there is not a sympathetic soul in it besides yourself and Tommy the Marconi operator. And even he relapses into incomprehensible talk of jiggers, and damped oscillations, and spark-gaps, and all that sort of thing."

"It sounds interesting."

"Not nearly so interesting as the tip of your nose," replied Harry.

A CHANCE DISCOVERY.

His condition was not formally accepted, but it was conceded in fact. Harry joined Nessie in the cross-examination of Mr. Sullivan, but the witness seemed to detect their motive. He became more genially vague than ever. The *Sobrina* had completed her tour of the Mediterranean, traversed the Suez Canal, and entered the Red Sea before Harry had found out a single fact about Mr. Sullivan.

Even then it was merely the discovery that the man had once worn a beard.

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At the end of a day when Mrs. Lynwood had been *hors de combat* under the tropical heat, Harry had managed to inveigle Mr. Sullivan into the smoke-room for a game of poker. During the game, when Mr. Sullivan had been intent on a particularly keen piece of bluff, Harry noticed him raise his hand to stroke an imaginary beard. His expression changed for a moment when he discovered that there was nothing there to stroke.

The man was plainly disconcerted, and looked keenly at his companions to see if they had noticed his action. They all appeared, however, to be intent upon their cards. Mr. Sullivan drew a long breath and rubbed his chin ostentatiously.

As soon as the game was finished Harry slipped away to interview Tommy in the Marconi cabin. The result of the interview was that Tommy despatched a message to Jack Soames, one of London's cleverest solicitors, "yet," as Harry himself said, "one of the few who have given me briefs." The message inquired whether anything was known of a man Sullivan (minutely described in police fashion) who had once worn a beard.

Eventually the reply was received—the reply which Harry had generously prepaid. It was very short and to the point: "*Do not be an ass.*"

SULLIVAN RIPENS.

Harry had confided the beard mystery to Nessie, but he had said nothing about his message to Soames. It was too long a shot to be likely to hit, and Soames's answer made him thankful that caution had kept him silent.

Meanwhile Mr. Sullivan was ripening fast as a possible husband for Mrs. Lynwood. She found his manners perfectly charming, and did not perceive that the secret of his success lay in the way that he encouraged her to talk about herself and to confide her thoughts and feelings to him.

Therefore while Mr. Sullivan went ahead, Nessie and Harry were bogged in despair. Harry was particularly doleful as the *Sobrina* neared Ceylon.

"We shall sight land to-morrow morning," he said to her, as they paced the deck together. "It is a sad look-out for my promise."

"I do not think that I shall be very hard on you," replied Nessie. "But our luck may turn any minute. Perhaps we shall catch Sullivan tripping when we and he least expect it."

"Perhaps," echoed Harry dolefully.

However, the *Sobrina* had left Colombo and had gone the best part of the 3,000-mile stretch to Fremantle before their luck turned. The happy event occurred on the King's birthday, which was celebrated on board the *Sobrina* with intense patriotism and a huge consumption of liquor.

Harry had twitted Mr. Sullivan with being a Nationalist leader in disguise. He told him that the general impression on board was that he was going out to Australia to raise a Fenian gang to settle the Irish question in the good old way. For once Mr. Sullivan's suavity was destroyed. He vehemently resented Harry's bantering, and went so far as to swear in Mrs. Lynwood's hearing—at which the lady smiled indulgently.

This was enough for Harry. Before dinner he had a confidential chat with the officers and most of the male passengers, none of whom had the slightest objection to asking Mr. Sullivan to drink the King's health. The ship's doctor was the first to challenge him when the champagne was served out. Mr. Sullivan patriotically stood up and drank half a glass to His Majesty, God bless him! Then the first officer followed, and the chief engineer and several of the passengers in succession.

When dinner was over, and the ladies had retired, Mr. Sullivan was in a mood to treat the situation as a joke. He joined in the laughter raised by each call of "Mr. Sullivan, the King!" and when a speech was hilariously demanded he rose unsteadily to his feet and grinned contentedly.

A FALSE MOVE.

"Gentlemen," he began, "I rise to ask you to drink to the health of His Majesty the King. But before asking you to honour yourselves by observing that almost sacred toast, I would like to take this opportunity of defending myself against the base charges which have been circulated against me. I ask you to observe that I have already drowned these charges in more champagne than I ever drank in my life before.

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I am a teetotaller because my stomach bears the same relation to my constitution as Ireland does to England—it is always tending to revolt. But I would like to dissipate the last shadow of Fenianism from my reputation by relating to you an incident which occurred during the visit of the King to Ireland. You are all aware that extra precautions were taken to prevent any untoward accident. But there was one plot of which the police authorities had no knowledge. Information regarding it came to me in the most casual and unexpected way, and though it was at a real and imminent risk of my life, I sought an interview with the Lord Mayor, who was a personal friend of mine. He said to me, after he had heard my story: 'It is impossible for us to thank you openly, but I can assure you, my dear Gandy, that——'"

Here the speaker stopped suddenly. His jaw dropped, and his eyes stared wildly over his audience. He was like a man suddenly sobered by the spectacle of a crime. After an interval of painful silence he tried to speak, but the mumbled words were lost, and he sank back heavily on his seat with his story unfinished.

GANDY? GANDY?

Harry stepped out and searched for Nessie. He found her in a sheltered corner of the bridge deck.

"Miss Lynwood," he said, "I want you to help me. Where have I heard the name Gandy before?"

"How can I possibly tell you that?"

"Have *you* never heard it?"

"Somewhere, and some time, I suppose. But the name, sweet as it is, has no memories. Why?"

"Because it has associations for me—associations of villainy, like the names of Charlie Peace or Brigham Young. Now, let me think. I shall go through the calendar of crime, and get at the right thing by a process of exhaustion. That's scientific."

"But I don't see——"

"You will presently. Now, let's begin at the top. Murder, manslaughter, wounding with intent to do grievous bodily harm, burglary, housebreaking, petty larceny, forgery, blackmail, bigamy——" He jumped up and then sat down again, and gripped her wrists. "Miss Lynwood," he exclaimed, "I've got him—I've got him by the throat! Gandy the bigamist! Gandy, the man who ran away from woman number three and took all her money with him! Gandy, the man that the police have been hunting all Europe for! Was there ever such a lark?"

He told Nessie the whole story of his discovery.

"Oh," she said, "if it were really so——"

"Well, if—if it were, what then?"

He looked closely into her eyes. She smiled back at him. "If it were," she replied, "I should be very pleased."

"I shall expect to be thanked," said Harry, "as I am sure you never thanked a man before."

"How do you know that?"

"Because you have never been engaged to be married."

"Oh!" she murmured, and remained silent for a while. When she spoke again it was in a very business-like voice.

"You had better proceed to expose your villain."

"Oh, no, I shall not. If I were to denounce him in front of your mother, he would counter me with a plausible yarn, and your mother would believe him and abuse me. Nothing but handcuffs will convince your mother."

"Don't be too cruel, Mr. Stenhouse."

"This is a desperate case, Miss Lynwood. We have got to give Mrs. Lynwood a real shock, and you must leave this business to me."

"You are very masterful, Mr. Stenhouse. I can feel your grip on my wrists yet."

"Oh, I am sorry."

Nessie smiled, but she did not say that she also was sorry.

TOMMY AND THE ETHER.

An hour later Harry shut himself in the Marconi cabin with Tommy.

"I want you," he said, "to send another message for me to London."

Tommy gazed at him solemnly. Then he took a chart from a shelf, opened it, and pointed to a spot in the middle of the ocean.

"That is where the *Sobrina* is at the present moment," he said impressively. "She is fitted with a 1½-kilowatt installation, which has a range of 500 miles, and you ask me to send a message to London."

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Harry sighed. "I did not think you would ever use the word impossible."

"I did not say it was impossible," Tommy replied.

"Then you must do it."

"I can't do it," declared Tommy, with an air of profundity, "but the ether can, if it chooses. Have you ever heard of freak messages?"

"Mine is a freak message. It reads: '*Gandy the bigamist on board* SOBRINA *under name Sullivan—inform police.*'"

"I don't mean that kind of freak," said Tommy, as if the presence of bigamists were a trifle. "I mean the wireless signal that carries hundreds of miles beyond its legitimate distance. I remarked to you once before that the ether is a queer thing sometimes."

"Well, I hope it is feeling exceptionally queer just now. What are the odds on a freak message going through?"

"Oh, about one in a thousand," replied Tommy, as if he had made the calculation often.

"That is more than the odds on a happy marriage," commented Harry. "Now, fire ahead. I give you a hundred pounds if that message hits the mark."

Tommy waved his hand with a gesture which hinted that money should never be mentioned to young men with theories about the ether. Nevertheless he worked with scientific zeal to make the second message to the unbelieving Soames carry across the thousand or two miles which separated the *Sobrina* from the nearest wireless station.

"OH, DEAR!"

In spite of the commanding air which he assumed with Tommy, and the contented manner he adopted with Nessie, Harry was quite certain that the ether had swallowed up his message. One might as well shoot peas at the moon, he told himself. When he got to Fremantle he would need to take the matter up with the police there, and ten to one Gandy would get wind of his operations and disappear a second time. That would be a victory in a sense, but not the dramatic victory which his soul desired.

He felt little more than the idle curiosity of most of the passengers when the health officer's boat approached the *Sobrina* outside Fremantle. Even the presence of two additional men in the boat did not suggest anything to him.

He stood near the head of the gangway, with Nessie and Mrs. Lynwood and Mr. Sullivan leaning on the rail close to him. One of the men following the health officer spoke a few words to the officer at the head of the gangway; the officer pointed to Mr. Sullivan, and the man stepped forward and touched him on the shoulder.

"Mr. Gandy," he said, "I hold a warrant for your arrest on a charge of bigamy and misappropriation of funds."

Mr. Sullivan spun round and put his hands out; the other man took the opportunity of slipping handcuffs on them.

It was all done so quickly and so quietly that Mrs. Lynwood did not realise what was happening until Mr. Sullivan was being led away. Then she looked at Nessie as a child might look at her mother after an earthquake shock.

"What does it mean?" she whispered

"It means, mother," replied Nessie, "that Mr. Sullivan is a felon."

"Oh, dear!" gasped Mrs. Lynwood, and promptly collapsed on to the deck.

* * * * *

She did not reappear until the *Sobrina* was nearing Melbourne. During that time Harry saw little of Nessie, and he had to console himself with the company of Tommy, who was preposterously proud of the success of his freak message. "It will make the Marconi service green with envy," he said.

Strangely enough, Mrs. Lynwood was very gracious to Harry when they met again, so gracious, in fact, that Harry was allowed many hours alone with Nessie.

"We owe all this to Tommy," he said to her one evening. "You ought to go and kiss him."

"He would not appreciate it."

"Perhaps not. He is too young to think of anything but the ether. But I am not too young, and in another thirty or forty years I shall be too old. It has occurred to me that I ought to begin at once. I am waiting for you to say 'thank you' in the only really satisfactory manner."

And in this case, although a powerful transmitter was close to a sensitive receiver, it was apparently found necessary to repeat the message an indefinite number of times.

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ADMINISTRATIVE NOTES

New Italian Station

WE have received particulars regarding the new station at Genoa, Italy, which has been opened in place of that at Cape Mele, recently dismantled. The station is officially known as that of Genova (call letters I C B), and its geographical position is 44° 25′ 44″ north; 8° 56′ 02″ east of Greenwich. It is equipped with Marconi apparatus for a range of 160 miles, and wave-lengths of 300 and 600 metres. The station will be open day and night for general public service, and the coast rate for messages has been fixed at 30 cms. per word.

* * *

Telegraphs in Morocco

REGULATIONS concerning the Spanish Protectorate in Madrid are published in the *Gaceta de Madrid*. These regulations provide that concessions for certain public works, including wireless telegraph installations, will be dealt with by the Delegado de Fomento and then laid before the Governor-General, who will advise thereon. Wireless telegraph, telegraph and telephone services will be subject to the administration of the Jalifa.

* * *

Compulsory Wireless for Canadian Vessels

THE Government Bill respecting the use of wireless telegraphy on Canadian vessels finally passed the Marine Committee on February 14th. The Bill proposes to make it compulsory to have wireless (*a*) on vessels licensed to carry fifty or more people, including crew, plying 200 miles; (*b*) on vessels licensed to carry 250 or more people plying more than 90 miles; and (*c*) on vessels carrying 500 or more and plying more than 20 miles. The apparatus must be capable of transmitting and receiving messages, night and day, over 100 miles, and have a competent operator. Certain amendments were passed while the Bill was before the Committee, the effect of which is to exempt from its operations Northumberland Straits, Bay Quinte (north shore), Georgian Bay, the Toronto and Hamilton Line, and rivers and small lakes.

* * *

Progress of the Canadian Stations

THE last annual report of the Canadian Department of the Naval Service contains the usual section devoted to the operations of the wireless stations round the Canadian coast. The service of these stations has been maintained and operated at the general high standard of efficiency which is shown in the satisfactory increase in the number of words handled for the year ended March, 1912—namely, 2,851,350 words compared with 1,826,895 during the corresponding period of the preceding year. This increase is said by Mr. C. P. Edwards, the general Superintendent of the Government Radiotelegraphs, to be due to the fact that the reliability of the service is becoming more widely known among mercantile houses. Cable interruptions are a source of considerable revenue for the service. Two breaks of importance occurred during the year, one on the United States Government Alaskan cable between Seattle and Alaska, the other on the cable between Prince Edward Island and the main land. In the former case a large number of messages were handled *via* the wireless station at Ketchihan, Alaska, and the Prince Rupert station, and in the latter all the messages to and from Prince Edward Island were handled *via* the stations at Pictou and Cape Bear. This business was handled without difficulty, and the utility of the wireless service thus further demonstrated. There were no breakdowns or interruptions of communication between any of the wireless stations during the year.

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CONTRACT NEWS

THE Compagnie de Télégraphie sans Fil, of Brussels, have arranged to equip three cargo steamers of the Nederland Steamship Company with ½-kw. and emergency sets, and two of their passenger steamers with 1½-kw. and emergency sets. The Rotterdamsche Lloyd Company are having a cargo steamer fitted with ½-kw. and emergency set, and are making arrangements to have another of their passenger steamers fitted. The K. Hollandsche Lloyd are to have two more of their passenger steamers, *The Houtman* and *Van Lansberg*, fitted with 1½-kw. and emergency sets, and possibly a further two. The Tug steamer Company of Muhlen are also to have one of their vessels fitted.

Three short-range stations have been erected for the Police Department of Rotterdam. The Chief Office at Parkhaven is now similarly equipped, while two river steamers have had wireless installed recently.

* * *

That the Minister of Railways at Ottawa may be able to keep in close touch with the progress of the work, and be enabled to send supplies or equipment without a long and tedious wait that the return steamer trip necessitates, it has been decided to establish a wireless service between Le Pas and Hudson Bay terminal when the harbour work is started. "Whether the Bay station will be at Fort Churchill or Port Nelson depends upon the choice of the terminal, and no official announcement is as yet forthcoming," states the *Montreal Gazette*.

* * *

It is reported that a scheme will shortly be laid before the Canadian Government for the establishment of a chain of wireless stations from Athabasca Landing up the Mackenzie River to Herschel Island, and thence to Rampart House in the Yukon. The erection of stations at these points, it is felt, would be useful not only in opening up the country and in obtaining scientific data of the far north, but would be of immediate assistance to the Royal North-West Mounted Police, and to the Meteorological Department by bringing it into touch with a vast unknown territory whose prevailing conditions may influence its forecasts.

Orders have been received by the Marconi International Marine Communication Co. to equip or to refit the following vessels

Owner.	Name of Vessel.	Installation.	Remarks.
Messrs. Gellatly, Hankey & Co.	s.s. *Pathan*	½ kw. and emergency set	General trade.
The Royal Mail Steam Packet Co.	s.s. *Andes*	1½ kw. and emergency set	Travelling in South American waters.
,, ,, ,,	s.s. *Alcantara* ..	,,	Travelling between Southampton, New York, and West Indies.
Liverpool and North Wales Steamship Co.	s.s. *La Marguerite* ..	,,	Passenger and pleasure boat travelling between Liverpool and North Wales watering-places.
The Leyland Line	s.s. *Ibernian* ..	,,	These vessels carry a limited number of passengers, but their transport trade between Liverpool and Boston is very considerable.
,, ,, ...	s.s. *Atlantian* ..	,,	
,, ,, ...	s.s. *Caledonian* ..	,,	
,, ,, ...	s.s. *Etonian* ..	,,	
Messrs. Furness, Withy & Co.	s.s. *Iowa*	,,	Engaged in general trade; no fixed destination.
,, ,, ,,	s.s. *Digby*	,,	Engaged in general trade; no fixed destination.
,, ,, ,,	s.s. *Shenandoah* ..	,,	Engaged in general trade; no fixed destination.
,, ,, ,,	s.s. *Kanawha* ..	,,	Engaged in general trade; no fixed destination.
,, ,, ,,	s.s. *Rappahannock* ..	,,	Engaged in general trade; no fixed destination.
The Petroleum Carriers, Ltd.	s.s. *C. A. Canfield* ..	½ kw. and emergency set	Oil steamer.
,, ,, ,,	s.s. *Norman Bridge*	,,	Oil steamer.

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The following vessels have been equipped with Marconi Apparatus during the past month.

Owners.	Name of Vessel.	Installation.	Remarks.
Messrs. Gellatly, Hankey & Co.	s.s. *Pathan*	½ kw. and emergency set	General trade.
Messrs. Anglo-American Oil Co.	s.s. *Tonawanda* ..	½ kw. and emergency set	Cargo vessel between Baltimore, Philadelphia, and New York.
Ellerman Line	s.s. *Kabinga* ..	½ kw. and emergency set	Trading vessels engaged principally in Eastern waters.
,, ,, ...	s.s. *Kalomo* ..	½ kw. and emergency set	
The British India Steam Navigation Co.	s.s. *Nevasa*	1½ kw. and emergency set	Passenger between Calcutta, Rangoon, and the Straits.
,, ,, ,,	s.s. *Teesta*	,,	Passenger between Calcutta, Rangoon, and the Straits.
,, ,, ,,	s.s. *Tarola*	,,	Passenger between Calcutta, Rangoon, and the Straits.
The White Star Dominion Line	s.s. *Welshman* ..	,,	Passenger travelling between Avonmouth or Liverpool to Portland, Maine.
,, ,, ,,	s.s. *Englishman* ..	,,	
Messrs. Elder, Dempster & Co.	s.s. *Appam* ..	,,	Passenger between Liverpool and Lagos.
Messrs. Lages	s.s. *Itaquera* ..	,,	—
,, ,, ...	s.s. *Itaqiba*	,,	—
The Nelson Line	s.s. *Highland Pride*	,	Cargo vessels carrying limited number of passengers between London and Buenos Ayres.
,, ,, ...	s.s. *Highland Warrior*	,,	
Ellerman Line (City Line) ..	s.s. *City of Benares*	,,	Passenger between England, Bombay, and Karachi.
Tyser Line	s.s. *Marere*	,,	These vessels go eastward to Australia and New Zealand, returning through the South Atlantic.
,, ,, ...	s.s. *Muratai* ..	,,	
New York and South American Line	s.s. *Crofton Hall* ..	,,	Passenger between United States and South American States.
Leyland Line	s.s. *Georgian* ..	,,	Trading between Liverpool and Boston with accommodation for passengers.
,, ,, ...	s.s. *Iberian*	,,	
The Booth Steamship Co. ..	s.s. *Vincent* ..	,,	Southampton *via* Portugal to Madeira.
White Star Line for Board of Trade	Ice scout *Scotia* ..	,,	Patrolling North Atlantic ice-fields.
Messrs. Howard Smith & Co.	s.s. *Canberra* ..	,,	Destined for Australian waters.
Union Steamship Co. of New Zealand	s.s. *Niagara* ..	,,	General trading in New Zealand waters.
The P. & O. Steam Navigation Co.	s.s. *Benalla* ..	,,	Destination undetermined.
Allan Line	s.s. *Parisian* ..	,,	This fine fleet of passenger boats travel between England and North America or the United States. They were amongst the first to be equipped with wireless, and are now being refitted with the latest apparatus.
,, ,, ...	s.s. *Ionian*	,,	
,, ,, ...	s.s. *Corinthian* ..	,,	
,, ,, ...	s.s. *Victorian* ..	,,	
,, ,, ...	s.s. *Virginian* ..	,,	
,, ,, ...	s.s. *Scotian*	,,	
The R.M.S.P. Co.	s.s. *Thames* ..	,,	Travelling between Southampton and South America; refitted.
The Nederland Steamship Co.	s.s. *Batjan*	½ kw. and emergency set	Cargo vessels between Holland and the Dutch East Indies.
,, ,, ,,	s.s. *Boeton*	½ kw. and emergency set	
The K. Paketvaart My. ..	s.s. *Rumphius* ..	1½ kw. and emergency set	Passenger and mail steamers visiting Dutch East Indies.
,, ,, ,,	s.s. *Hector Treub* ..	1½ kw. and emergency set	
,, ,, ,,	s.s. *Tasman* ..	1½ kw. and emergency set	
The Rotterdamsche Lloyd Line	s.s. *Murjek* ..	1½ kw. and emergency set	An important line of passenger vessels.
,, ,, ,,	s.s. *Torne*	1½ kw. and emergency set	
,, ,, ,,	s.s. *Bandoeng* ..	½ kw. and emergency set	Cargo vessels attached to the same service as the preceding.
,, ,, ,,	s.s. *Soerakarta* ..	½ kw. and emergency set	
The Tras. Esp. Line	s.s. *Reina Victoria Eugenia*	5 kw. and emergency set	One of the largest Spanish passenger boats.

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Maritime Wireless Telegraphy

FOR some time past Trinity House has possessed a regular system of wireless communication between some of the principal Channel lightships and the lighthouses around the South Coast, and navigation has been greatly benefited thereby. Now Liverpool possesses a similar system, for the lightships at Bar and Formby have recently been fitted with wireless installations. The service is to be restricted solely to the purpose of life-saving, and will secure a much greater degree of safety in the navigation of the Mersey channels.

* * *

An innovation which will be much appreciated by passengers from the Continent has been introduced by the South-Eastern & Chatham Railway on board their steamers from Calais to Dover and Boulogne to Folkestone. On application being made to the Marconi operator during the passage, first and second-class seats will be reserved in the connecting boat trains from Dover or Folkestone to London by means of the wireless telegraphy on board the steamers. No charge whatever is made for this facility.

* * *

There have been lately several French vessels disabled by the storms which have made this winter remarkable. One was the mail steamer *Sebri Brihim*, which left Marseilles for Oran on Tuesday, February 18th. She had not proceeded far before her steering gear broke down, and her captain was obliged to send a wireless message for help, which was received at the station near Pomegues and at the Lizard. Immediately tugs were sent to assist her, and she was towed into Marseilles on the following day.

* * *

Another French vessel which came to grief was the liner *Mexico*, which was hopelessly disabled by the severe storm. Her "S.O.S." call was first answered by the *Galileo*, who stood by the distressed vessel until the *Devonian*, one of the Leyland steamship liners, came in touch and made arrangements to tow the *Mexico* to Halifax. Wireless telegraphy played an important part in these manœuvres, for it was only by the reception of the message that the *Devonian* was at all able to locate the *Mexico*. As soon as the disaster was known, however, the s.s. *Florida*, a sister ship to the *Mexico*, received instructions by wireless while in mid-ocean to proceed to the disabled vessel and render whatever assistance might be necessary. Immediately the *Florida* set about to carry out these instructions, and made a long detour from her course, braving heavy seas and dense fogs, in a hopeless effort to find the crippled liner. Finally, however, she received further information by wireless that the *Mexico* had been taken in tow by the *Devonian*, so that the *Florida* was able to proceed without further hindrance to Halifax.

The *Devonian* succeeded in bringing the *Mexico* to port, but not without considerable difficulty, for the journey was made through a succession of gales, but there was no danger of further mishap, for continuous communication by wireless was kept up between Camperdown and the two ships.

It was very fortunate for the *Mexico* that she was fitted with Marconi wireless apparatus, as her cargo is valued at more than a million dollars. As it is, the *Devonian's* crew will be able to claim some fifty thousand dollars in salvage money, making the *Mexico* one of the richest prizes that have ever fallen to the lot of a merchantman to tow into an American port.

* * *

Another vessel which has cause to be grateful to wireless telegraphy is the liner *Crown Point*, which was drifting rudderless and in a helpless condition in mid-Atlantic when it was picked up by the French mail and passenger steamer *Chicago*, bound from New York to France. The *Chicago* herself

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was unable to do more than send a wireless call for assistance, as she herself was unable to delay on account of the mails on board. The message was received at Queenstown, and arrangements were made for a vessel to go to the distressed liner's assistance.

* * *

The Canadian-Pacific Railway have decided to run two Round-the-World tours in connection with the maiden sailing trips of their new steamships the *Empress of Russia* and the *Empress of Asia*.

breaker, fitted up with all the latest appliances besides Marconi wireless apparatus, and with engines that will make it the swiftest vessel of its kind, will be launched shortly by the Reid Newfoundland Company.

* * *

Marconi wireless telegraphy and submarine signalling apparatus are features of the new Royal Mail steamer *Appam* (8,000 tons gross), which is now on her maiden voyage. Built for the British & African Steam Navigation Company, Ltd., by Messrs. Harland & Wolff, the *Appam* embodies the

A View from the Marconi Station at Camperdown (Nova Scotia). The C.P.R. steamer "Empress of Ireland" can be seen passing the Automatic Buoy, near the scene of the wreck of the "Uranium."

The Montreal Shipping Federation of Canada has pointed out that owing to the mildness of the winter liners can negotiate the St. Lawrence River without difficulty, while if the Government would send an ice-breaker to open up the further reaches of the river the whole of the St. Lawrence route could be opened up without much difficulty. There would be little fear of further obstruction from newly-formed ice, as after February the rapidly-growing power of the sun makes such a condition of things impossible. A magnificent ice

latest principles of watertight construction, having six watertight bulkheads, dividing the structure into seven watertight compartments.

* * *

The *Zealandic* has just returned to London after a five months' voyage to New Zealand. On her outward journey she passed the Cape of Good Hope and returned via Cape Horn. Throughout the whole of the voyage she was in complete wireless communication, not a single day passing without the reception and transmission of messages.

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Our Bookshelf

"A HANDBOOK OF WIRELESS TELEGRAPHY," by Dr. J. Erskine Murray. (London: Crosby Lockwood & Son, 10s. 6d.)

That this book, which saw the light of day in 1907, should have already reached its fourth edition is evidence alike of the rapid advance of wireless telegraphy and the determination of the author to keep his work fully up to date. Dr. Erskine Murray has again thoroughly revised his book and added much new matter, and we have little to add in its praise since our review of the third edition some months ago. We note, however, that none of the points which we criticised on that occasion have been revised by the author. We are particularly surprised to find that a whole chapter and several beautiful illustrations should still be devoted to Tesla's world-wave telegraphy. In our opinion a paragraph in the historical section of the book would have sufficed for this subject, and the practical character of the work under notice would certainly not suffer by the alteration suggested. The new chapter on the "Telegraphic Efficiency of Wireless Means of Communication" is particularly interesting, and the author's methods are in marked contrast to those so often adopted for determining the efficiency for advertising purposes. All the more important factors in the efficiency of a pair of stations are touched upon, though it is obviously impossible to reduce them to a mathematical expression. The author has also added, as an appendix, the draft specification of the Imperial wireless stations, but it is certainly news to us that these stations are to be at Chelmsford, Egypt, Aden, Bangalore, East Africa, and Singapore!

* * *

"THE PRACTICAL ELECTRICIAN'S POCKET BOOK AND DIARY, 1913." (London: S. Rentell & Co., Ltd. 1s. net.)

This little book, measuring only 5½ inches by 4 inches, is as convenient to carry about as it is valuable to engineers, to whom it can be safely recommended as a thoroughly reliable *vade mecum*. There are a number of useful tables, and the information is essentially of a practical character. In a section devoted to telegraphy there is a brief reference to wireless telegraphy, the only feature of which worth mentioning being a table of wireless stations which is hopelessly antiquated. However, it is not possible to deal with so vast and important a subject as wireless telegraphy in a small pocket-book, and apart from this we cannot but comment favourably upon this well-established pocket-book, which contains much information that will be useful to telegraph engineers.

* * *

"WIRELESS TELEGRAPHY SIMPLY EXPLAINED." (London: Percival Marshall & Co. No. 37 "Model Engineer" Series. 6d. net.)

The title of this little book describes its contents accurately. Unlike many small books recently published on the subject, it gives no instructions for making the apparatus, but limits itself to presenting a clear idea of the most important principles and methods. It is therefore a book which every amateur who proposes to start experimenting in "Wireless" would do well to read before tackling those volumes which occupy themselves mainly with the apparatus and its construction. Like the other volumes we know in this useful series, it is free, so far as we have noticed, from the occasional "howlers" which one comes across from time to time in elementary manuals. We cannot, however, approve of the last page, where among the "Signs of Punctuation" the full stop is given as "a.a.a." instead of "i.i.i.," and other signs are also rendered in an unorthodox manner.

A serial story entitled "A Pawn in the Game" will commence in the May number of the WIRELESS WORLD. The tale should prove of great interest to our readers, for, besides dealing with the important problems of the moment, it has a strong love interest, and contains many original character studies.

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THE IMPERIAL WIRELESS SCHEME

THE SELECT COMMITTEE.

OFFICIAL notice of the re-appointment of the Select Committee on the Marconi Contract was given on March 13th. There is no change in the personnel of the Committee who were nominated on October 23rd. The last sitting was held on February 12th, when Mr. L. J. Maxse, editor of the *National Review*, was examined.

On February 25th a further special report by the Select Committee was issued. It stated that the Committee passed the following among other resolutions:

That the Committee propose retaining the conduct of the inquiry entirely in their own hands, but will accept the assistance of counsel (if the leave of the House be obtained) when they think it necessary;

That any persons or body deeming themselves interested who wish to appear by counsel shall make application in writing to the clerk, stating the grounds upon which they desire to appear.

POSTMASTER-GENERAL'S REPLY TO THE COMPANY.

In reply to the further letter from the Marconi Company stating that, after March 1st, they would no longer consider themselves bound by the contract of July 19th last for the Imperial Wireless Scheme, the Postmaster-General has caused the following letter to be sent:

February 24th, 1913.

GENTLEMEN,—I am directed by the Postmaster-General to acknowledge the receipt of your letter of the 20th inst. stating that after the 1st prox. the Marconi Company will no longer consider themselves bound by the contract of July 19th last.

In reply I am to repeat that the Postmaster-General does not share the company's view that they have any right to retire from the contract, and to say that he will hold himself free to enforce all his rights against the company.

I am, gentlemen,
Your obedient servant,
A. F. KING.

MINISTERS' LIBEL ACTION

IN the list of cases to be mentioned in Mr. Justice Darling's Court on March 19th were the libel actions brought by the Postmaster-General (Mr. Herbert Samuel) and the Attorney-General (Sir Rufus Isaacs, K.C.) against *Le Matin*. The actions arose out of statements published in *Le Matin*—a widely circulated paper in Paris which has offices in London—and had reference to the Marconi contract. Sir Edward Carson, who appeared for the Postmaster-General and the Attorney-General, said both actions were brought in respect of a libel of a very serious character "charging the Postmaster-General and the Attorney-General with certain delinquencies which were of a public nature."

The statements were subsequently admitted by the defendants to be false, and on February 18th they published in their paper this apology:

London, February 17th.—Special Telegrams of the *Matin*.—Under the heading "A Financial Scandal in England," I sent you on Thursday last an abstract of the rumours which had been current with regard to the accusations brought by Mr. Leo Maxse, editor of the *National Review*, against Mr. Herbert Samuel, Sir Rufus Isaacs, the Attorney-General, and his brother, Mr. Godfrey Isaacs, managing director of the Marconi Company.

The official documents of the Parliamentary inquiry, which I have just read, in no way confirm these rumours—far from it. It appears therefrom that Mr. Maxse simply said in answer to his questioners that he had repeated rumours which were floating about, and that he could in no case give the source of his information.

Under these circumstances, and pending the publication of the discussions, I take the earliest opportunity of sending you this correction with an expression of regret that I should, in perfect good faith, by communicating current rumours to you, possibly have done an injury of any sort to three men of quite unimpeachable honour.

Following the issue of the writs, added counsel, the defence put in repeated the publication of this apology, with the expression that they had no intention of making any imputation upon the honour or conduct of the plaintiffs.

Judgment was given for plaintiffs with an indemnity for costs.

Alleged Libel

The trial of Mr. Cecil Chesterton for an alleged libel in the *New Witness* on Mr. Godfrey C. Isaacs, managing director of the Marconi's Wireless Telegraph Company, will be held at the Old Bailey Sessions which commence on April 22nd.

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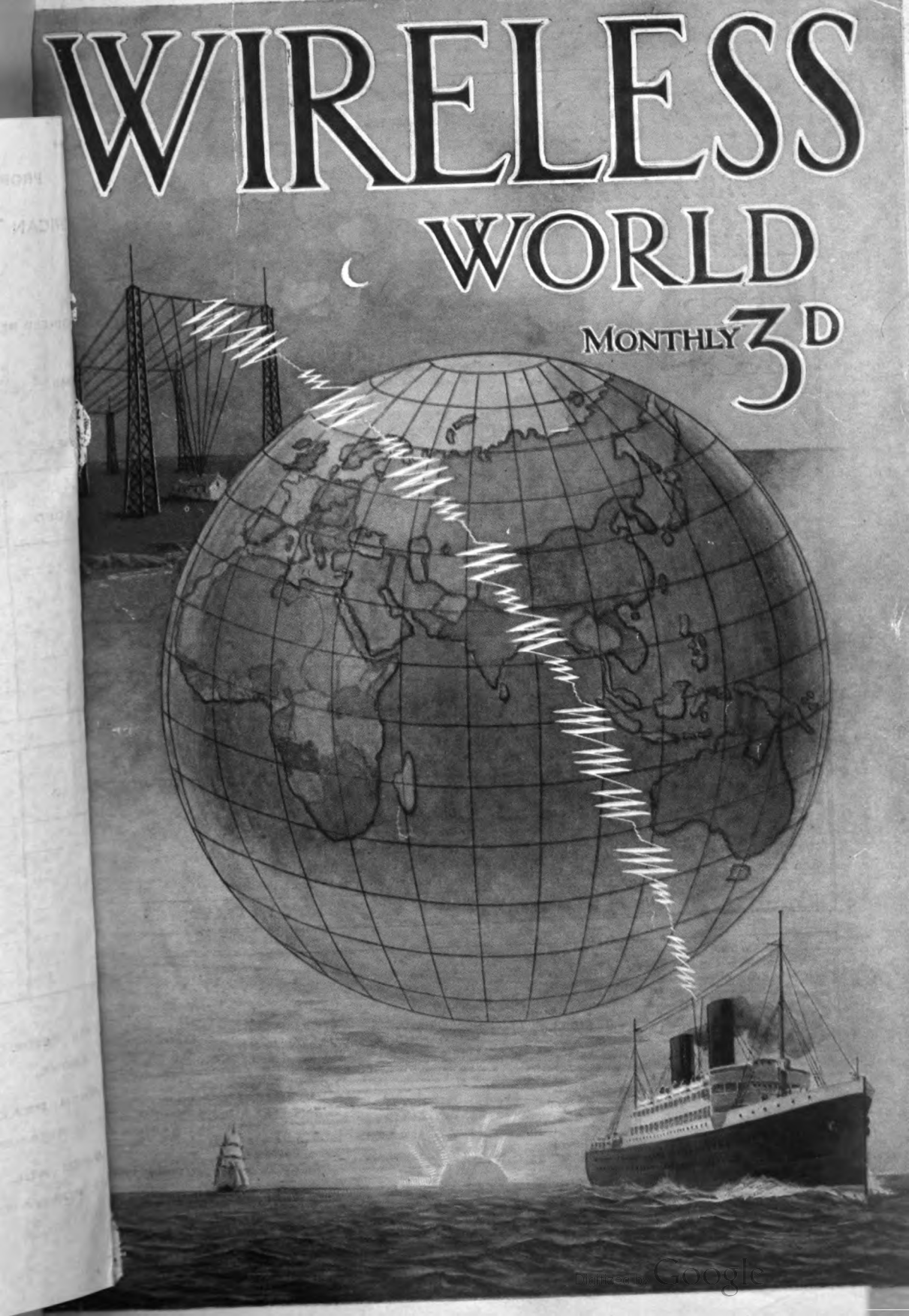

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The Wireless World.

With which is incorporated "The Marconigraph."

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All Editorial communications to be addressed to "The Editor, 'The Wireless World,' Marconi House, Strand, London, W.C."

The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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THE
WIRELESS WORLD
with which is incorporated
The MARCONIGRAPH.

Vol. 1.—No. 2. (NEW SERIES) May, 1913.

Subscription 5/0 per annum post free.

Price 3d.
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"The Wireless World" and its Reception.

IN presenting the first number of THE WIRELESS WORLD last month, we do not think we were unduly sanguine in thinking that it would occupy a place in periodical literature which has hitherto been left unfilled. Its reception has justified the opinion that the magazine would meet a distinct need, and the cordial welcome which it has received from all quarters and from the technical and general Press encourages us to look for the rapid achievement of our object to make it "a magazine for everyman." The first number had an issue of fifty thousand copies, but, large as this quantity may appear, it was by no means too large to cope with the demand. An encouraging feature was the numerous "repeat" orders from newsagents and booksellers in all parts of the country. These facts are worth mentioning because they illustrate more strikingly than anything else can the great public interest in the subject of wireless telegraphy, and their eagerness to read about it when the subject is presented in such a manner that it will not be beyond their scope.

Gratifying, however, as is the measure of approval gauged through the circulation figures, that alone would fail to assure us if it were not for the generous letters of appreciation and congratulation that have reached us from readers, some of them old friends through the *Marconigraph*, and many more newly-formed acquaintances, to all of whom we return our best thanks for their kind messages. We welcome their support, not merely as readers, but as critics, correspondents and collaborators in the task which we have undertaken.

We are particularly impressed by the welcome of our scheme for the free instruction in wireless telegraphy of Territorials and of lads connected with the Boy Scouts Association and Church Lads Brigade, etc. This scheme has the approval of Lieut.-General Sir Robert Baden-Powell and Major-General E. C. Bethune, the Director-General of the Territorial Forces, and the inspiring messages which these leaders addressed to the members of their organisations through the WIRELESS WORLD last month has met with a gratifying response. In some centres Boy Scouts have decided to establish "wireless classes," which will be under the control of one or two of their senior colleagues; the basis of instruction at these classes to be the series of articles which commences in the present number.

The "amateur's" interest in wireless telegraphy is now so great that all over the country there are hundreds of young men investigating its mysteries merely as a scientific hobby. This is a spirit which should be encouraged, and we are willing to guide and assist honest investigators in their studies. With this object in view we have opened a "Question and Answer" section in THE WIRELESS WORLD, and we invite amateurs to communicate with us upon points concerning which they desire information.

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M. GASTON PÉRIER.

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Personalities in the Wireless World

M. GASTON PÉRIER

Managing Director of the Société Anonyme Internationale de Télégraphie sans Fil.

IT may be counted to the advantage of any young industry that there should be associated with it men of great business capacity. But wireless telegraphy has been fortunate in that such men were readily to be found; men who could gauge its capabilities and its importance to mankind. Among these is M. Gaston Périer.

When the new discovery was yet a phenomenon, almost, one might say, a chimaera, M. Périer became interested. Hereafter he followed intently every movement in its rapid development, and so was of the first in the field with practical assistance for establishing it on a working basis.

Born at the Hague in 1875, Gaston Périer was hardly 21 years of age when he obtained an honours degree as Doctor of Laws at the Brussels University. It had always been the intention that he should become a barrister; so now that his college training was over he was articled to Maître Beernaert, and for a long time practised under this eminent statesman, whose recent death is still fresh in our memory. As is the case with most young lawyers, or at least with those determined to make a mark in their profession, he specialised in his subjects, and devoted himself, as much as was in his power, to cases dealing with business transactions. In this way he gained a very real and extensive knowledge of the management of a large house of business and the conditions of commercial life.

So it was that when Colonel Thys asked M. Périer to collaborate with him in the management of a vast array of colonial and financial enterprises, he was able to take up the position of an active and influential business man, and be of immense assistance to his father-in-law. It was in this connection that he became interested in wireless telegraphy, for Colonel Thys is President of La Compagnie de Télégraphie Sans Fil, of Brussels. Then the Marconi International Marine Communication Company, Ltd., the new enterprise, was fortunate enough to obtain his services as secretary. Later, in 1908, he was appointed one of the Directors, combining this with the functions he already exercised; a few weeks ago he was appointed as Managing Director of the new Société Anonyme Internationale de Télégraphie sans Fil. Besides this he is on the Board of Directors of the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie, m.b.H., of Berlin. Further, as collaborator with Colonel Thys and M. Travailleur, M. Périer has done much for the development of wireless telegraphy in Belgium and other Continental countries.

But other people have been anxious to secure the help of M. Périer's brilliant business capacity. He is a Director, and negotiates the colonial affairs of the Banque d'Outremer, and is a Director of the following companies:—The Compagnie du Katanga, the Oriental Congo Company, The Intertropical Anglo-Belgian Trading Company, The Compagnie du Lomani, The S.A.B. du Haut-Congo, The Société Coloniale Anversoise, The Antwerp Telephone and Electrical Works, The Etablissements Hutchinson de Paris (Rubber and Tyres), the General Sandur Mining Company, Limited, and the Central Africa Railway Company.

In conclusion, let us add that M. Périer has obtained a high place among his compatriots, not only for his quality as a captain of finance and industry, but as a man of probity, intellect and good-fellowship.

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EPISODES OF THE MONTH

OUR FRONT COVER. THE DERELICTS COMMITTEE REPORT. HOW WIRELESS HAS MINIMISED THE DANGER FROM DERELICTS. THE VOYAGE OF THE "NEW ZEALAND."

THE jagged white streak across the cover of this magazine will be read by telegraphists at a glance; others, unless they have a friend acquainted with the Morse Code, will wonder what it means. The key is simple; ▬ is a dash, and ▪ is a dot. Hence the streak spells :—

▬▬ ▬▪ ▬▪▬ ▬▪▬▪ ▬▬ ▬▬ ▬▪ ▪▪

M A R C O N I

But since the message is being sent from the land station (artistically representing Poldhu) to the ship, the letters were actually sent in the reverse order, spelling INOCRAM, which looks like a code word.

* * *

The streak tempts us to some further reflection. The artist has evidently meant to portray the conception of a wireless station at night sending a message to a ship enjoying the beauties of sunshine; the streak just stretches half-way round the globe. Apart from the fact that there is no record of a wireless message having been received at that distance, it would appear at first sight that the length of the message—namely, about 12,400 miles (half the circumference of the earth)—is a stretch of artistic licence. In reality, however, the message is far longer, which we proceed to show. Good operators can send and receive wireless messages at the rate of thirty words a minute, or, in other words, one Morse word in two seconds (an average word being considered to be five letters). Here we have seven letters; the time taken to send this word is, therefore, $\frac{7}{5} \times 2$ or 2·8 seconds. Now, wireless waves travel at the rate of 188,000 miles a second; hence a simple calculation will show that the real length of the streak is 526,400 miles, more than twice the distance to the moon. In the same way it can be shown that each dot is 9,400 miles long, and each dash 28,200 miles long. When it is decided to send a dot the telegraph key is depressed for only the one-twentieth of a second. As a result a series of trains of electro-magnetic waves is produced, the total duration of the series being one-twentieth of a second, and the first train will be 9,400 miles away before the last train leaves the wireless station.

* * *

The problem of the protection of shipping from derelicts, which has recently been considered by a Departmental Committee appointed by the Board of Trade, is one which, while apparently easy of solution, in reality presents considerable practical difficulties. The committee which sat in 1894 held that the danger of collision with derelicts in the open sea was very small, but the number of vessels—and presumably the number of derelicts—has increased since 1894. The present committee reduce this judgment to the statement that "the number of dangerous derelicts on the high seas is not great," and point out that the danger is chiefly confined to the western portion of the North Atlantic, and that most of the derelicts are of American origin. Wireless telegraphy has in the meantime been developed, and has already been installed upon a large number of steamships, and the committee appear to have, from the outset, borne particularly in mind the possibilities of wireless telegraphy and its bearing on the question of disseminating to ship masters and others information as to derelicts sighted and the increased probability of finding derelicts by vessels despatched to remove them. They review in their report the steps which have been taken to minimise the extent of danger caused by derelicts, and here it is obvious that, by an improvement in the system of collecting and distributing, information received by wireless telegraphy can effect an appreciable diminution of the danger.

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During the year ended 31st August, 1912, only nine reports of derelicts and wreckage were addressed by masters of ships to the coast stations, and 131 messages were sent from the stations to passing ships warning them of the dangers. The small number of reports addressed to the coast stations is apparently due to the fact that the masters of vessels fitted with wireless apparatus report to a large extent to their owners either direct or *viâ* other vessels. The staff of the coast stations were instructed by the General Post Office in March, 1910, to receive any messages relating to derelicts sent by passing ships, and to signal the information to other ships proceeding on the North and South Atlantic and North Sea routes, as the case may be, for a period of four days after receipt of the information. In the existing practice of reporting and publishing information concerning derelicts a certain amount of overlapping exists. This is a defect which has engaged the attention of the committee, who are of opinion that it might be remedied by means of a conference of the bodies concerned in the collection of news relating to derelicts. It is strongly urged in the report that a central body for the reception and dissemination of information should be established, and that every facility should be given to this body.

* * *

Great importance is attached to the employment of wireless telegraphy in the receipt of information and the issue of warnings to ship masters as well as to the notification to bodies in possession of means of removing or destroying the dangers. Various methods are at present adopted in sending by wireless telegraphy reports which relate to derelicts and floating wreckage in the North Atlantic. One method is for ships sighting the dangers to send reports to other ships by way of warning, and for retransmission to the shore. No charge is made on anyone in connection with the ship to ship messages, which are treated by the Marconi Company as masters' service messages. Reports are also sent from ships addressed to the Post Office Coast Stations, which retransmit them to passing vessels and to the Admiralty, Lloyd's and the Meteorological Office, the only charge arising out of these reports is the Inland telegraph charge for retransmission to Lloyd's. In the case of messages sent from ship *viâ* the coast stations, specifically addressed to Lloyd's or steamship companies, a charge for the use of the coast stations arises, and is borne by the addressees, together with the Inland telegraph charge. Lloyd's have also to pay the ship station charge. Reports are also sent from His Majesty's ships to the Naval wireless stations and the military, or *vice versâ*. The extension of wireless telegraphy on ships of the mercantile marine is an additional means of safeguarding life and property from the danger of floating derelicts which the committee have not failed to realise, and it would be an advantage if the steamers of the general lighthouse authorities and certain outlying lighthouses and lightships could be fitted with wireless telegraphy to warn masters of sunken wreckage in home waters. The co-operation which the committee would like to see between the British Navy and the Mercantile Marine with regard to wireless telegraph communications is not always practicable, owing to the difference maintained between the wave length of the commercial stations and those of the naval stations.

* * *

Messages from Wellington, dated April 12th, reporting the arrival of the battle-cruiser *New Zealand*, announced that "long before she entered the harbour a message of welcome, sent by the Governor of the Dominion, was taken in by her wireless installation." The importance of this achievement is not immediately evident in the message, for it is an ordinary everyday occurrence for communication to pass between a ship and land long before the ship enters harbour. But read in conjunction with other reports of the voyage of this notable vessel, the remarkable work of the wireless telegraph station on board soon becomes apparent. When on her way from South Africa to Australia, the *New Zealand* was able to keep in simultaneous wireless communication between the two continents, enabling Lord Gladstone and Lord Denman, the respective Governors-General of South Africa and Australia, to exchange greetings. For a wireless message to cover the long expanse of water between South Africa and Australia with only one relay is an achievement which opens vast possibilities in overseas communication.

B

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CARTOON OF THE MONTH

Wireless Terms Illustrated

II—Continuous Waves

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Gold Coast Cameos

The Wireless Telegraph Station at Accra

Life on the Gold Coast. The Natives and Wireless Telegraphy. Scenes in Accra. The New Station.

PROGRESS on the Gold Coast is like a recurring decimal—it goes on everlastingly, but never quite accomplishes anything. This, at least, is the general impression that strikes the luckless wight whom fortune sends to that quarter of the globe.

The establishment of a wireless station at Accra, however, seems an earnest of better things to come. Though not yet officially open—the first message was one of congratulation exchanged on Christmas Eve between the Governor and Commander-in-Chief, Sir Hugh Clifford, K.C.M.G., aboard the s.s. *Falaba*, and Major Bryan—the prospects for a public service are so promising that the question of opening stations at Sekondi and Coomassie is already under consideration. Successful experiments, in fact, have been conducted between Accra and Coomassie, a distance of 130 miles through dense bush, a portable set with two 70-ft. masts and a valve receiver having proved highly efficient for the purpose.

There is a big field for wireless telegraphy on the Gold Coast; in the service of many industries in course of development it should prove invaluable. In addition to its military uses, the Accra station will prove of uncommon service to shipping. The coast surf is

Accra: A Typical Street Scene

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at times so heavy that communication between ship and shore is frequently impossible for lengthy periods, during which business men ashore simply sit and fume to the grave detriment of their health in such an undesirable climate. Occasionally, too, an incoming ship has to report a case of yellow fever on board, and her officers being forbidden to land under the circumstances, communication can only be carried out by wireless.

The Accra Marconi station, which will be worked by the Post Office, will be open daily between 8 a.m. and 4 p.m., and at such other hours as occasion demands. Owing to the plague of white ants, which demolish everything in the nature of wood, timber is used very sparingly in the construction of the station. The mast is of steel, 200 feet in height, and the building itself of concrete bricks. The main aerial is of the umbrella type, the second being a twin wire type aerial. The length of the wave normally transmitted will be 300 metres, but the station is capable of transmitting waves varying in length from 600 to 900 metres.

The equipment consists of a 5-kw. set driven by an oil engine. No special features distinguish the power plant. The prime mover is a 5 h.p. oil engine, to which is direct-coupled a 3-kw. continuous current dynamo, having a pressure regulation suitable for enabling it to be used to charge the accumulator battery of 54 cells. The motor alternator consists of a continuous current motor, designed to run off the accumulator battery and to drive a disc discharger mounted on an extension of its shaft. The transformer is designed to afford a transformation ratio of either 300 to 10,000 or 300 to 5,000 as desired.

A Saturday Evening Shopping Scene at Accra

Some clue to the lack of progress on the Gold Coast is to be found in the attitude of the seasoned old timers towards the new arrivals. One thousand seven hundred only, according to the latest census, is the number of white men out of a population of 1,502,900 in the 80,000 square mile area of the Colony, Ashanti and Protectorate, of which Accra is the chief town. Nor, with the sort of welcome they get, are these numbers likely to increase by leaps and bounds. The

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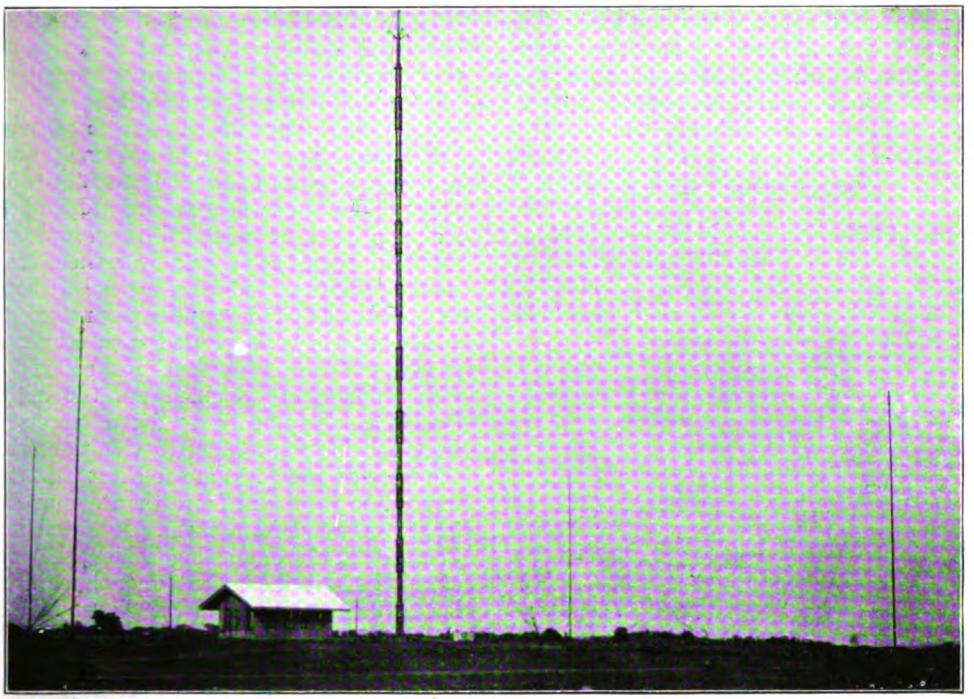
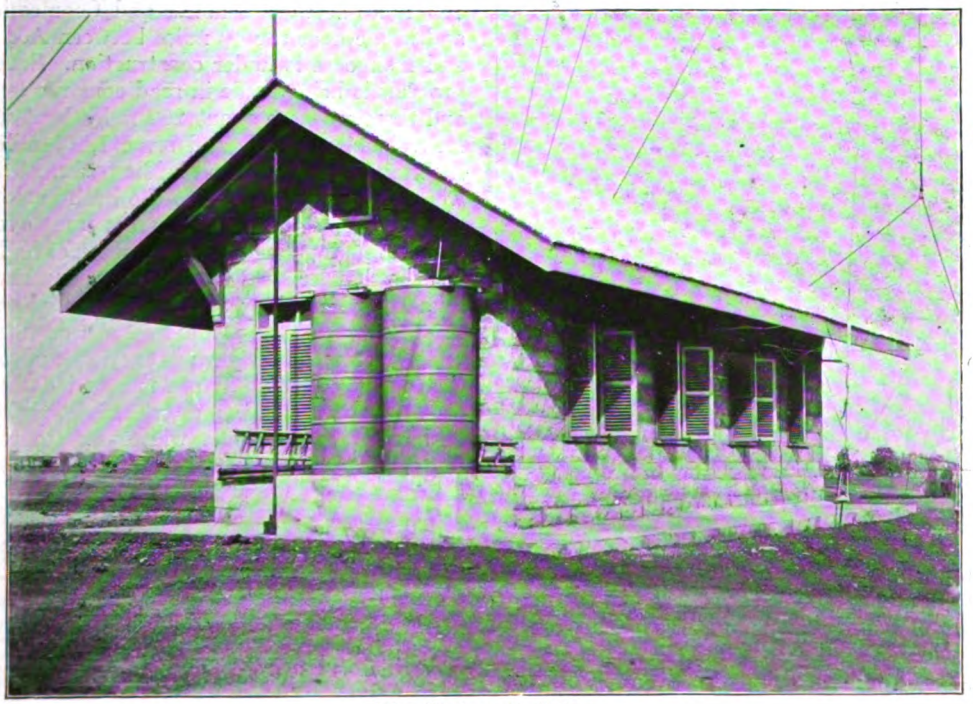


View of the Accra Station



The Station Building

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climate on the coast is notoriously "the deuce," though they express it at greater length and with astonishing eloquence out there. There goes a story, probably quite exaggerated, of a gentleman who came out from foggy, yet salubrious, England to stir things up on the coast. He observed on his

Picking Palm Kernels on the Gold Coast

arrival that the flags ashore—exceptionally numerous they were, too, on this occasion—were all at half-mast, and was informed that an official had died. Later a gloomy deputation—the "welcome" committee—came aboard and, standing at a distance to avoid fear of contamination—so they incidentally let fall during their remarks—hinted that not only had the official expired of fever, but that scores of the inhabitants were doing likewise. To this diplomacy they put the credit that the threatened increase of one in the white population never came about. The discreet traveller, like the illustrious Duke of York, of whom it is recorded about his men that he marched them up, and marched them down, and marched them back again, returned whence he had come as speedily as circumstances permitted.

The newcomer is regaled with stories of death and burial in four-foot coffins, in which bodies are doubled up, the actual local economy being rendered necessary from the fact, according to tradition, that the trees on the coast are so short that it is impossible to obtain more than a four-foot length of wood from them. Initiated into Coast life in this depressing fashion, the newcomer feels it incumbent upon him in his letters home to keep up the "agony." So the dog has got rather a worse name than he ought to have.

A more serious barrier to progress in this region is the lack of facilities for transport. There is a Government railway covering the 168 miles between Sekondi and Coomassie, and a line over the 40 miles between Accra and Mangoase is under construction. Some progress is being made in road construction, and there are now about 200 miles kept up for vehicular traffic, and some 1,800 miles maintained as tracks and bridle paths. The work of cutting paths into the bush is slow and difficult. Commonly trees are over 200 feet high; some are over 400 feet high. Of the barrier that faces the roadmaker Miss Mary Kingsley wrote: "In the light of brightest noon the forest-wall stands dark against the dull blue sky; in the depth of the darkest night you can see it stand darker still, against the stars; on moonlight nights and on tornado nights, when you see the forest-wall by the lightning light, it looks as if it had been done over with a coat of tar."

There are in the Colony 1,424 miles of telegraph line and fifty offices, and telephone exchanges at Accra, Cape Coast, Sekondi, Tarquah and Dodowa. But the difficulty of laying line through the bush is immense and militates against its extensive use. There are other disadvantages, too. Alfred Kinnear, the war correspondent, thus de-

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scribed the uncertainty of the field telegraph service during the Ashanti campaign: "Very frequently the line was 'disturbed.' A passing tornado, which in West Africa consist of a hurly-burly of thunder, lightning, and the deluge, promptly created a disturbance in the line of communication. Perhaps a tree would fall and break the cable, and, in any event, the electricians had to count with one permanent foe—the extreme humidity of the atmosphere and ground. To another and more humorous foe they had also to look. This was a muddle-headed superstition of the natives, as well as a love of 'loot' which forms so deep a vein of native life. Whole lengths extending from twenty to forty feet of wire were 'cut,' and the material twisted into bracelets and necklets for the decoration of the dusky village beauties of both sexes. . . This will account for the brevity of the description given of the occupation of Coomassie, as well as the surrender of its King."

Horses cannot live on the Gold Coast, owing to the ravages of the tsetse fly. There is little wheeled traffic, but the bicycle has become quite fashionable. The general mode of travel is by hammock, and there is nothing more picturesque than the stately progression of a heavy man swaying gently between the bending poles which strain from the shoulders of his team of dusky carriers. Most of the work of transportation—indeed, the bulk of the work of any kind—is done by women, and everything is carried on the head. Send your "boy" for a bottle of whisky—a very popular "food" on the West Coast—and he brings it back on his head; on the road to school the youngster carries his slate on his woolly cranium.

A little digging or some dilatory carpentry is the utmost effort to be got out of the native as a rule. He loves the lazy life, and, living in a hut little better than a shed, contrives to earn about 1s. 6d. a day and live at the rate of 5s. to 6s. a month. Gin and his wives are his chief diversions. Gin is plentiful, and wives are to be had from £5 upwards, according to the age, position and state of

Receiving Room at the Wireless Station

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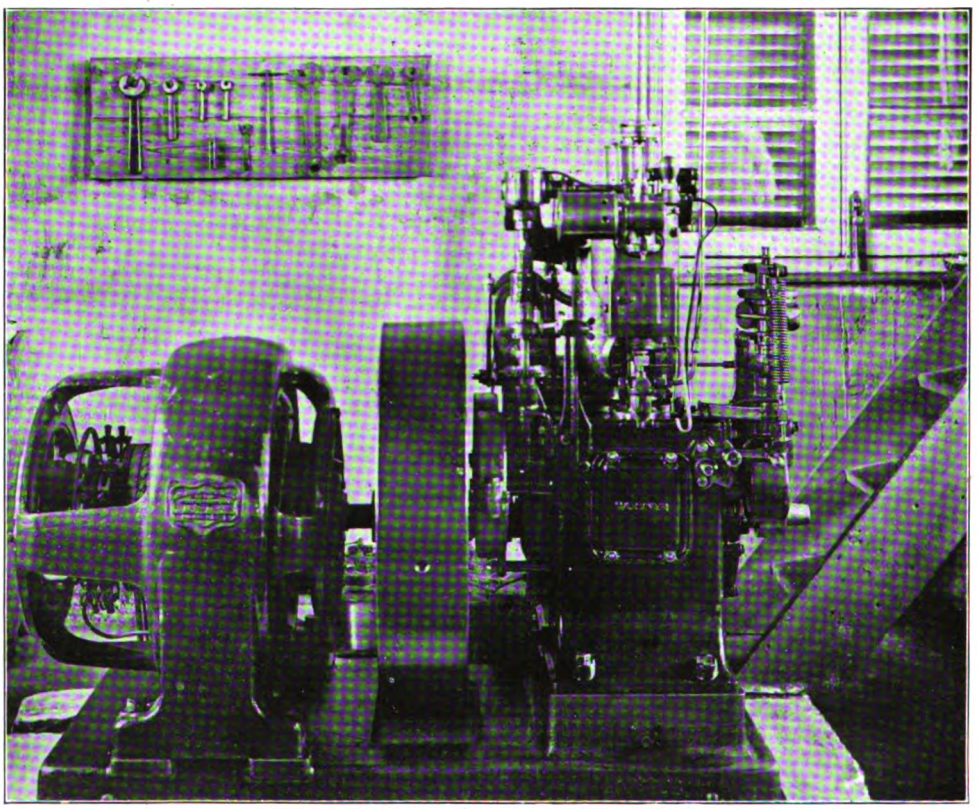
the black girl to be taken in wedlock. The Fantee of the Coast is excruciatingly funny as a dude ; he is somewhat of a quick-change artist, too. He comes to work in European clothes, a pith helmet, and an umbrella to keep off the sun ; on quitting work he dons a loin cloth and a broad smile. He is an expert at theft, and has a distinct partiality for bicycles, lead and clothes. He is, moreover, a master of terminological inexactitude. Lying is as ingrained in him as thirst. has to be kept on him. The law is administered by District Commissioners, who are Europeans, and they, in the absence of other responsible Government officials, assume various administrative duties. The District Commissioners preside over courts which deal with petty offences, but in the courts the judge is assisted by a jury of natives. The native witness will lie with the facial innocence of a Reynolds cherub, but his toes betray him. They are con-



Engine and Generator at the Accra Station

Reminiscent of the French-while-you-wait books of our youth, he will excuse a day's absence from work (and there are many, for he is a work-shy individual) on the plea that his "mother's sister's aunt died," or is dying ; and when reproached for making use of his distant relations in this fashion, will solemnly assure you : "*Me no li, massa.*"

So frequently does the native stray from the paths of rectitude that a very sharp eye stantly on the move as he lies stalwartly, and judge and counsel watch not his eyes but his toes. The witness box is built to facilitate this, for "so prominent a part do the toes play in the search after truth," says one writer, "that the witness-box, from the feet to the knees of its occupant, is constructed open," and adds that as a preliminary to an orgy of lying he takes the oath by heating two pieces of iron together, remarking : "If I tell a lie, I go

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in bush, and snake bite me, I die. I tell lie, go in canoe, and I die. I tell lie, what I eat poison, I die." But in spite of it all he, like the light that lies in woman's eyes, lies, and lies, and lies.

The native rather enjoys a period of prison—it is so restful. That prison has no terrors may be guessed from the story of a warder who became inebriated while in charge of two prisoners. He managed to get them to the gaol, when he discovered that he had left his gun behind him. One of the prisoners

Portable Receiving Set at Coomassie

In the centre is Mr. Geary, Chief Engineer of the Gold Coast Telegraphs, with Mr. J. Robertson, Telegraph Instructor, on the right, and Mr. C. James, the Marconi Engineer in Charge, on the left. The natives were engaged on mast work.

promptly guarded the warder, and the other, doubtless with some little glee (for the native is not allowed a gun, and a white man is liable for a £20 fine if he sells him one), went back for the weapon. On returning, the trio found to their dismay that the gaol was locked. Obligingly the native climbed over the wall—and was later summoned for breaking into prison! He took his punishment in the light of a summer holiday.

The native boy rather fancies himself as a vocalist, a "gift" that has been "developed" under the tuition of the missionaries. The European bears with him patiently as a rule, but it was rather too much when a young "blood" who had been engaged in the wireless station on the erection of the masts celebrated their completion by climbing aloft and bellowing hymns, interspersed with variations of "God Save the King." "Patriotic, but irritating," was the only balm to his soul after the violent reception with which he met when he set foot on the ground again. The native, as a rule, has more respect for the wireless, believing that by some witchcraft the wind brings the message until the wires catch it.

Snakes, scorpions, hyænas, mosquitoes, flying cockroaches and sandflies complete the happy family amongst which the Europeans live, and of whose presence they are constantly and unpleasantly reminded.

Thursdays bring a variation in an uncommonly dull daily menu, for the incoming steamer brings "chop" in the form of refrigerated butter and other delicacies; palm oil "chop" which is a special dish reserved exclusively for Sundays. The *Gold Coast Leader*, a sheet due wholly to native enterprise, provides the colony with breakfast-table topics day by day. Beyond that there is little to encourage one to live.

The last bolts on the Accra mast were fixed by the Postmaster-General, Mr. Somerville, Mr. Crewe, Mr. Rolkstein, Mr. Micklewright and operator Miles.

The following letter, dated February 10th, was sent by Mr. J. Somerville, the Postmaster-General of Accra, to Mr. C. James, the engineer in charge of the construction of the station:

I have the honour to inform you that the wireless station at Accra erected by you has been inspected and passed as in every way satisfactory.

(2) I have to congratulate you on the efficient way the work has been done and especially on the way you have overcome the numerous difficulties that are incidental to carrying out work in this country.

(3) I regret the delays that have occasioned your staying in the country much longer than was originally expected. I should perhaps mention that these delays arose from circumstances over which you had no control.

(4) I offer you especially my congratulations on having erected the mast with unskilled native labour without any accident.

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A Visit to Macedonia

During the Balkan War

By B. St. J. S.

The Author has recently returned from a tour through Servia and parts of Macedonia in Servian occupation. He describes his experiences and impressions.

A COUNTRY in a state of war presents features of absorbing interest to the visitor, and Servia is no exception. Having just returned from a trip in Servia, and parts of Macedonia in Servian occupation, perhaps I may be permitted to record some casual impressions of the country, and of the attitude of a people at this supreme crisis of their destiny. It is certainly appropriate to do so in THE WIRELESS WORLD, because one of the things that interested me most was wireless telegraphy. I had heard a good deal about portable wireless telegraph apparatus for military purposes, but I had never seen this marvellous invention as it is used during war time until I encountered a Marconi station at Nisch.

This history and character of the people of Servia are epitomised in Belgrade, the seat of the Government, which would be impressive even to the casual visitor in times of peace. This city affords an arresting contrast to the great European capitals. It does not offer the pleasures, the refinements, the luxuries of the latter; it gives us no picture of great sections of the community passing their days in idle amusements. The buildings may be crude, yet no man who had eyes to see and ears to hear could doubt that he was in a city of real men. Belgrade impresses the visitor as a city of simple, hardy, strong people, building up a national life amid incredibly difficult conditions, and working out their destiny with patience and courage hardly ever excelled.

Here the existence of a state of war is evident only in the national spirit and the return of the wounded; it is on the journey from Philippopolis onwards to Adrianople that the havoc of war is most notable. The railway route from Nisch till Philippopolis is reached is comparatively devoid of incident. On the other hand, the journey from Nisch towards Kumanova and Uskub, which form the centre of the second zone of Servian operations, is full of dramatic interest. Even Nisch, old frontier town in Northern Albania, is a seething camp full of wounded being taken back to Belgrade, while the very air is pungent with the odour of iodoform. Ox wagons for transporting provisions come pouring in from the country side, some laden with wheat and maize, others with oats, rye, and tobacco. Sometimes great vats of wine (a peculiar brand, made from a species of prune grown in large quantities round about) and wagons filled with barrels of brandy rumble heavily along, while occasional herds of swine and goats are driven in from the country side to replenish the commissariat. Fat goats and pigs they are, too, for beech forests abound in Servia, and throughout the Balkans generally, and the fallen beech nuts give a rich pasturage to the livestock who are allowed to roam at will and nose out the fallen fruit.

But travelling is awful—worse now than at the beginning of the war, and then it was bad enough. A journey, which in the ordinary course of events would have taken twelve hours cannot be timed to finish under, possibly, two days—perhaps three. The country side is entirely deserted, and practically the only signs of human occupation is to be found in the sentries who, at regular intervals, guard the entire railway route.

The whole region is chiefly given up to

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agriculture, except in the more mountainous districts, and even here the low slopes of the hills are prepared for cultivation, usually for vines. But now everything is in a state of chaos; the fields are neglected for want of overseers, and the women, who act as labourers, have not the heart to continue their work. As a matter of fact, numbers of them were at the time I visited the country with their husbands at the front, and to a large extent the transport work and the commissariat were in their hands.

Owing to the augmented traffic, and the passing and repassing of innumerable and heavy vehicles, the roads, which are generally constructed of beaten clay, instead of being properly metalled with stone, have been pounded into mud, often knee-deep in places.

At the commencement of war everything was dried up and parched by the summer heat, and the present quagmire was then nothing but a maelstrom of dust. It covered everything; it got in the eyes of the traveller and made them smart and tingle, while it burnt the throat and parched the lips and mouth; nor could the torment be assuaged by drinking, for water, and in fact every beverage, was practically unprocurable.

But the fertility of Albanian soil is remarkable; wherever the surface of the ground has been scratched with the primitive instruments in use amongst these primitive people it yields abundantly crops of wheat, maize, and tobacco. It is a pity that more up-to-date methods of cultivation cannot be introduced. Attempts have been made in this direction by foreigners, but the people seem to be unable to appreciate these advantages, and the only incident of the employment of modern methods that came to my notice was the discovery of an up-to-date threshing machine in the courtyard of a Pasha's house, which had been recently evacuated. The chances are this man was

A 1·5-k.w. Marconi Cart Station at Nisch in communication with a station of smaller type at Uskub—160 kilometres

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an Albanian—possibly an emigrant from the south—for the southern Albanians are an extraordinarily clever race.

But the Balkans as a people, and amongst these must be included the Montenegrins

1·5-k.w. Station at Uskub with Surgeons of the British Red Cross Contingent

and Servians, are not an economical lot; they only pay sufficient attention to agriculture to secure a sufficiency for their immediate needs, with the result that only about three-fourths of the land is cultivated. This is due, not so much to their indolence, as to their restlessness. They have this characteristic with the Montenegrins; all the vices and virtues of a border tribe, they are hardy, courageous, and, in a clumsy way, strategists.

There is nothing about the Serb to suggest military efficiency. For the most part these improvised soldiers are clad in rough and ready-made uniforms. Some are provided with military boots, but many wear only native-made mocassins, and all have their trousers tucked inside their socks.

But the war has brought out all the finest qualities of the race. They have stuck to it in spite of vast and overwhelming difficulties, which would have struck terror into a less hardened race. Their food supply has scarcely been sufficient to replenish the exhausted energy caused by the fatigues of war. Under favourable conditions each man gets a kilo loaf of bread, but such bread is of a very low quality—nothing more than a mixture of flour and rye. This is augmented by eight grammes of meat, and, what is perhaps of still greater advantage, soup can generally be obtained from the canteen. This is most necessary, for some hot nourishment does more than anything to increase vitality, and so counteract the cold, which is very severe, especially at night, because it is often accompanied with heavy rainfall, and consequent humidity.

At Vrania the country becomes more mountainous, and continues so until Uskub is reached. This, no doubt, accounts for some of the Servian successes, as the difficult nature of the country, affording greater scope for guerilla warfare, equalises the chances of invader and defender, and makes the outcome of success less dependent on generalship. Such a statement must not be taken too literally, for clever handling of troops and strategic manœuvring have played a most important part in bringing out the present results, but it must not be forgotten that a great part of the Servian army is composed of raw recruits, and these, though honest and obedient, and with a certain aptitude for the game, are at the best only a poor substitute for trained material. When to this is added the fact that Vrania and Uskub and Kumanovo are all of them strongly fortified and garrisoned positions, the victories of the Servians in this campaign must be looked upon as little short of marvellous.

Perhaps the secret of their success is the fact that the war appeals to the populace in

Servian National Dance

two ways; it is to them not only a war of national aggrandisement, but also a religious crusade, in fact there is little doubt that it is this secondary view of the case which appeals most strongly to the lower classes.

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They are not as a whole a religious people, but they are intensely conservative and impressionable, with a tendency to superstition. Furthermore, the history of their church is wrapped up with the history of their nation. When the past history of Servia and the national pride of the Servians is remembered, it is easy to understand the rejoicing that took place when Uskub was captured.

This little town is all the world to Servia. For centuries it was the capital of her Tsars, and it was a sad day for the little Balkan nation when, in the fourteenth century, the Turks, after the capture of Constantinople in 1345, overran the whole of the Balkan Peninsula, occupying town after town till Servia's capital was forced to acknowledge Turkish rule. Uskub is situated on the left bank of the River Varda, at the foot of a wide valley dividing the ranges of Shar Planina and Karadagh, and its position is most picturesque. As one looks out from the old citadel, the surrounding hills seem to close her in like Nature's bulwarks keeping guard over the city. The craggy heights come out sharp against the sky line, while their base is hidden by thick woods of beech and fir. I know not what condition prevails now, but a few weeks ago the heights were covered with snow, and the effect was awe-inspiring beyond words. Through the valley runs the Roman aqueduct, which remains from the days when Scuppi was a town of some importance and considered worthy of the patronage of Justinian. This is what Servia has regained for herself. Uskub is of great strategical importance, for here is the junction of the railways between Nisch and Mitrovitza and Salonika. The command of a railway is always a matter of supreme importance in modern warfare, for, as Lord Kitchener, who has probably more experience of railway warfare than any soldier living, has laid down as axiomatic, "there is nothing more difficult permanently to destroy than a railway." Of course this has not been accomplished solely by the efforts of raw recruits or an enthusiastic peasantry. These have only been made use of by the

A scene in the Native Market, Uskub. A Bulgar Peasant girl in gala costume is selling native pottery

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Servian army to accomplish their purpose, and it goes without saying that the Servian standing army is composed of very different material. It is highly trained and efficiently equipped, and stands next to Bulgaria in this respect. For instance, its artillery is estimated to consist of 228 quick-firing field guns and 36 quick-firing mountain guns, besides a fair stock of older weapons, which are held as a reserve.

But I was told that Servia, when preparing for war, included among her purchases four Marconi wireless stations. Before the purchase was completed trials were made of the apparatus at Belgrade. The stations were all of the latest portable wagon type, and were scheduled to have a range of 150 kilometres over normally flat country, although I was informed that during the campaign they often established communication over a distance of more than 160 kilometres, and on one occasion there was a mountain range of between 1,400 and 1,800 metres between. The preliminary tests were made as severe as possible, and included a trial run of 100 kilometres over a truly eastern type of road —that is to say, no road at all, but a series of ruts and ditches, with here and there a boulder to negotiate. This was in order to ascertain the durability of the wagons, and the security of the wireless apparatus inside. The results, however, were entirely successful. The interest taken in these trials was truly remarkable, and it was necessary to post sentries round the apparatus to keep the curious country folk at a distance.

The stations were taken into immediate use, and the Servian soldiery showed a very intelligent comprehension of the methods of erection and the working of them. So much so, that within a week of their arrival the corps who had charge of them were able to erect and dismantle them without the slightest difficulty. This speaks volumes for the simplicity and quality of the apparatus.

There is one particularly interesting novelty of the new stations. This is an ingenious arrangement which enables the operator to send on three different waves without stopping to make any adjustments, the whole transmitting apparatus being automatically adjusted to a different wave by the movement of a switch. A receiver connected to another three-way switch, enables the man at the other end to read the message quite as easily.

A simple analogy would show this clearly. Suppose a man could only read a message from a white lamp, whilst another could read white, red and green lamps in indiscriminate order, the man capable of reading all the coloured lamps would get the message, whilst the other man would only get disjointed words, utterly meaningless. The importance of such an arrangement, where secrecy is required, is very obvious.

It was by means of wireless telegraphy that the foundation of an autonomous Albania was announced to the world, when on November 12th, 1912, the flag of a new nation—the black spread eagle on a red ground—was hoisted over the Government buildings at Durazzo. But perhaps to the general public its most important use was its service to the war correspondents. Much of the news that would have otherwise been censored—and the censorship has been rigorous to the last degree—was passed through to various papers by a roundabout route of wireless telegraphy, chiefly by means of ship stations. Such was the means employed by the well-known war correspondent, Mr. Donohoe, who telegraphed important despatches to the *Daily Chronicle* through the steamship *Dacia*, and the *Daily News* correspondent, who made use of the *Principesa Maria* for the same purpose.

But now the war seems to be almost over. There is a general feeling that things have gone far enough, and all the belligerents are tired out. How matters will finally be settled, it is difficult to predict. However this may be, one thing the writer does know, and that only too well, the correspondents and hangers-on in the campaign are wearied out. The game is played out, and peace alone can alleviate the wide-spread havoc and misery which are the wages of war.

COST OF MARCONI COMMITTEE.—Mr. Robertson (Parliamentary Secretary to the Board of Trade) in reply to Sir J. D. Rees, stated in the House of Commons at the beginning of April that he understood that the cost to date of the Select Committee on the Marconi Contract chargeable to the House of Commons Vote was approximately £970, and to the Stationery Office Vote £1,100.

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Adrianople and the First Wireless Siege

THE Siege of Adrianople will go down in history not only as a fine example of gallant defence by Turkish soldiers against the attacking armies, but it will secure a special niche because there, for the first time in warfare, wireless telegraphy played a notable part in aiding the brave defenders of the besieged city.

We are not yet able to give our readers the whole story of an event to which belongs the unique distinction of signalising the "first wireless siege," but we know sufficient of the experiences of the garrison to warrant the belief that the story, when it is told, will be one of absorbing interest.

It is impossible not to contrast this siege with others of which one reads in military history, or which are within recollection of persons who are with us to-day. Such a contrast emphasises the advantage which Adrianople enjoyed when compared, say, with Paris, during the last siege of which the city was only able to maintain communication with the external world by means of balloons and carrier pigeons. Sixty-four balloons ascended from Paris during the siege of 1870–1871. Two of these were blown out to sea and were never heard of again; several on their descent were taken by the Prussians, and a good many were fired at while in the air.

Adrianople was not dependent upon this unreliable means of communication, however, for, through the medium of a Marconi station,

A View of Adrianople

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the Government at Constantinople was kept in touch with all that passed in and around the city. Than Shukri Pasha, who with his gallant Turks kept his flag flying over Adrianople during one hundred and fifty-three stubborn days, no man knows better the value of, and the consolation afforded by, a wireless equipment.

With the portable wireless station, the only one with which Adrianople was equipped, Shukri Pasha had means of daily communication with the capital. Situated on the hill by the clock-tower, a prominent point in the besieged city, the little station did its work well, and encouraged the commander in a wonderful defence that first aroused the astonishment and then won the admiration of the whole world. Constantinople was kept constantly informed by wireless of Adrianople's losses during the bombardment, and it was with a pang of regret that, on the final assault, when the daily allowance of bread in the city was estricted to less than four ounces per head, made of millet, with a little barley and an admixture of cinders, one read the Lion of Adrianople's last message determining, ere he surrendered himself and his army, to blow up the wireless telegraph station.

The Institution of Electrical Engineers will hold a summer meeting in Paris commencing on May 20th. Among those who have promised papers is Commandant Ferrié, whose subject will be wireless telegraphy.

At the regular monthly meeting of the Institute of Radio Engineers, New York, held on March 5th, Dr. L. W. Austin, of the National Bureau of Standards, Washington, in a paper described some experimental experiences of his recent work on "The Variation with Frequency of Condenser Resistances." The Institute of Radio Engineers, which was formed by the consolidation of the Society of Wireless Engineers and the Wireless Institute, is now well on in its second year. The membership is still growing rapidly, and meetings are held on the first Wednesday of each month at the Colombia University.

PRIZE STORY COMPETITION FOR NAVAL WIRELESS TELEGRAPHISTS.

Two essentials that are required to tell a good story are picturesque descriptive powers and vivid imagination. Those who are familiar with many of the naval "yarns" that are current need not be reminded that the officers and men of His Majesty's Navy are not devoid of these gifts. With a view of encouraging naval wireless telegraphists to display their talent in this respect, and to give their colleagues in the naval maritime services the benefit of their experiences, but not of a technical nature, we have decided to offer a prize of £3 3s. (three guineas) for a story entitled:

"THE LIFE OF A NAVAL WIRELESS TELEGRAPHIST."

This story should deal with the conditions f service and relate any interesting episodes; it should be about 2,000 words in length, and should be accompanied by suitable photographs.

The manuscript should contain the name and address of the author, but a *nom-de-plume* may be used for publication. The story which obtains the prize will be published in THE WIRELESS WORLD. Manuscripts and photographs should be in the hands of the Editor, THE WIRELESS WORLD, Marconi House, Strand, London, W.C., not later than June 7th.

The Share Market

London, *April 23rd.*

Business has been restrained during the past month by the delay in bringing about a cessation of the hostilities in the Balkans. The prices of the various Marconi issues to-day are: Ordinary, $4\frac{3}{16}$; Preference, $3\frac{9}{16}$; Canadian, 15s. 6d; Spanish, $\frac{1}{16}\frac{8}{16}$; American, $1\frac{1}{8}$.

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Efficiencies in Wireless Telegraphy

By W. H. ECCLES, D.Sc., M.I.E.E.

Below is the first portion of an article in which efficiency coefficients are sketched and defined. It is pointed out that the transformations that are undergone by the energy supplied to the transmitting plant by the time that it is converted into vibration of the operator's ear-drum are so numerous that in order to estimate the efficiency of the signalling process as a whole the transformations have to be followed out in each system separately.

THE efficiency, electrical or mechanical, of any machine or process is usually defined as the ratio of power utilised to power expended. This mode of reckoning efficiencies has to be abandoned when, as in the study of the processes of wireless telegraphy, there is enormous and unavoidable contrast between the great power used at a sending station to make a signal and the minute power that reaches the ear of the receiving operator. Moreover, the transformations that are undergone by the energy supplied to the transmitting plant by the time that it is, in part, converted into vibration of the operator's ear-drum are so numerous and so different in the different systems of radio-telegraphy that in order to get an estimate of the efficiency of the signalling process as a whole the various steps of the transformations have to be followed out in each system separately.

Estimating Efficiencies.

Thus, in order to study the question scientifically, we are compelled to estimate the efficiency, and to introduce the efficiency-coefficient, at each step of the transformation. In a spark set, for instance, if we start with the power to the transformer, we have then to trace out in order the power to the spark-circuit, the power to the antenna, the power to the waves, the power to the receiving antenna, the power to the detector, the power to the telephones, and the power to the ear, and finally we arrive with a plethora of "efficiencies."

We will proceed to trace the power through these steps. For all systems a convenient starting point is that where the essentially "telegraph" part of the plant joins up to the machine or the mains that supply the station. Different systems of radio-telegraphy require different supply currents—a Poulsen arc requires direct current at, say, 600 volts; a spark plant requires alternating current at perhaps 200 volts, with a frequency of 50; and, whether the power can be bought from outside the station, or has to be generated by steam in the station buildings, we must take a point just behind the metering-point in the first case as the beginning of the plant essential to the particular system under consideration. As the processes the energy passes through are so different in different systems, we will first take, for the sake of definiteness, a typical small spark station, and we will outline the stages through which the energy passes in its journey from the mains to the receiving operator's ear.

In a Spark Station.

In a spark station the alternating current supplied is raised to the voltage required for sparking by means of a commercial transformer. The high-pressure current in each half-cycle charges the bank of condensers up to the sparking P.D., thereby storing energy in their dielectric in the electrostatic form—*i.e.*, the magnetic energy in the iron of the transformer becomes electric energy in the glass of the condensers. The spark-gap at last breaks down, and the

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condensers discharge through it with oscillation. In the charging process there are losses in the windings and in the iron of the transformer, and in the oscillating stage there are losses in the resistance of the conductors, in the glass of the condensers, and in the spark-gap. The first two can be reduced to insignificance, but the energy lost as heat, etc., in the spark is inevitably a large proportion of the whole energy of the train of oscillations.

Passing on, the oscillations in the primary are found to induce similar currents in the secondary (*i.e.*, the aerial) circuit to an extent which is dependent on the coupling between the two circuits. In any case, if the spark is kept going steadily, power is drawn steadily from the supply, passed on to the antenna, and disposed of by the latter. We may define the EFFICIENCY OF GENERATION OF ANTENNA OSCILLATIONS as the ratio

$$\frac{\text{Power delivered to antenna}}{\text{Power supplied to transformer}}$$

Now the question arises, How does the antenna dispose of the energy delivered to it? It disposes of it in three ways: in the first place usefully in making electric waves which travel outwards from the antenna; secondly, wastefully, in generating currents in the earth around the antenna; and thirdly, also wastefully, in producing joulean heat in its own substance. The quantity of the energy disposed of in these three ways may be taken as proportional to the square of the amount of current; and by the definition of the term "radiation resistance," we may say that the proportion of energy used in wave-making (which is the true function of the antenna) to that spent in joulean waste is equal to the ratio of the radiation resistance to the ohmic resistance; and thus, we may define the RADIATION EFFICIENCY OF ANTENNA as the ratio:

$$\frac{\text{Radiation resistance}}{\text{Total resistance of antenna}}$$

The useful energy is now carried away from the antenna in the form of electromagnetic waves. If the energy despatched from the antenna in a definite small period of time be considered, it is easily seen to become distributed over a space which increases with the distance from the antenna. Besides this dispersion, it may, as it goes, suffer absorption in the air, and in the surface of the land and sea; and finally, the portion of it which arrives within the absorbing range of the receiving aerial is absorbed and produces oscillations in that aerial.

Of course, only a very small fraction of the energy dispatched from the transmitting antenna reaches the receiving antenna; and if we were to reckon the efficiency of transmission by estimating that fraction, we should arrive at a figure of the order of 10-14. This would be an absurd way of reckoning the efficiency of transmission. It is therefore better to adopt some such definition as: THE EFFICIENCY OF PROPAGATION in any particular case is the ratio:

$$\frac{\text{Actual mean energy density near receiving antenna}}{\text{Mean energy density in the same region if absorption did not occur between the stations}}$$

The receiving aerial has oscillations excited in it by the waves, and this is equivalent to an absorption of energy from the waves. If the receiving apparatus has the same natural period of vibration as the incoming waves (*i.e.*, shortly, if it is "in tune" with the waves) the energy absorbed will be greater than if it were "out of tune" with them. This leads to the conception of an "efficiency of resonance." But supposing the receiving antenna to be in perfect tune with the waves, we have to remember also that the resonance-effects are more exalted with undamped waves than with damped waves. Thus, in order to define the resonance efficiency of a given antenna for a given kind of damped wave, it is best for us to imagine the sending antenna caused to emit first the given damped waves and afterwards waves of pure sine-form, *with equal powers*; and then to suppose for the sake of argument that the efficiency of propagation is unity, and define the RESONANCE EFFICIENCY as the ratio:

$$\frac{\text{Energy absorbed from the damped waves during a large number of trains}}{\text{Energy absorbed from the pure sine-waves in the same time}}$$

It is especially important here to keep in mind the proviso that the pure sine-waves

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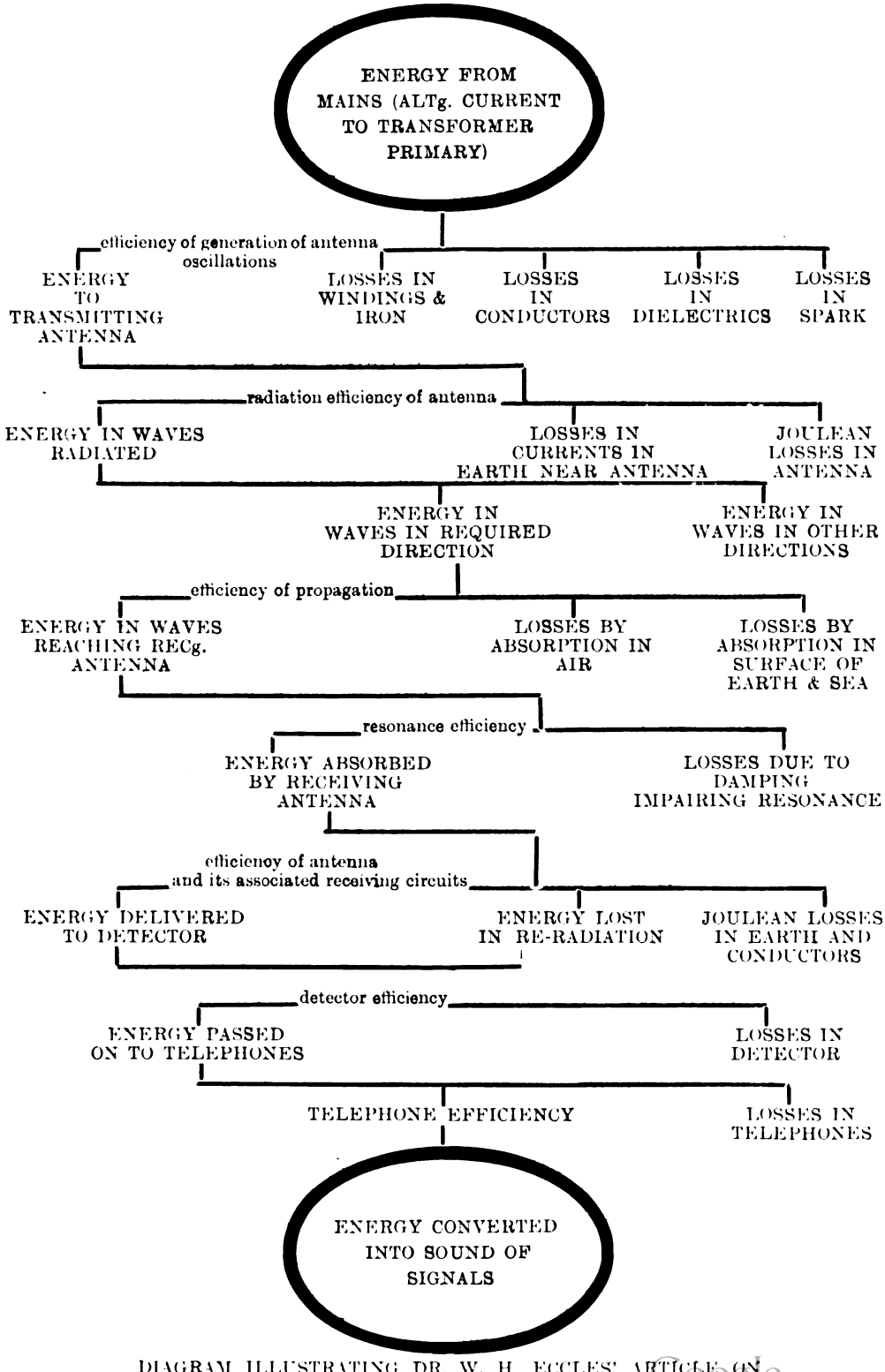
ENERGY FROM MAINS (ALTg. CURRENT TO TRANSFORMER PRIMARY)
efficiency of generation of antenna oscillations
ENERGY TO TRANSMITTING ANTENNA
LOSSES IN WINDINGS & IRON
LOSSES IN CONDUCTORS
LOSSES IN DIELECTRICS
LOSSES IN SPARK
radiation efficiency of antenna
ENERGY IN WAVES RADIATED
LOSSES IN CURRENTS IN EARTH NEAR ANTENNA
JOULEAN LOSSES IN ANTENNA
ENERGY IN WAVES IN REQUIRED DIRECTION
ENERGY IN WAVES IN OTHER DIRECTIONS
efficiency of propagation
ENERGY IN WAVES REACHING RECg. ANTENNA
LOSSES BY ABSORPTION IN AIR
LOSSES BY ABSORPTION IN SURFACE OF EARTH & SEA
resonance efficiency
ENERGY ABSORBED BY RECEIVING ANTENNA
LOSSES DUE TO DAMPING IMPAIRING RESONANCE
efficiency of antenna and its associated receiving circuits
ENERGY DELIVERED TO DETECTOR
ENERGY LOST IN RE-RADIATION
JOULEAN LOSSES IN EARTH AND CONDUCTORS
detector efficiency
ENERGY PASSED ON TO TELEPHONES
LOSSES IN DETECTOR
TELEPHONE EFFICIENCY
LOSSES IN TELEPHONES
ENERGY CONVERTED INTO SOUND OF SIGNALS

DIAGRAM ILLUSTRATING DR. W. H. ECCLES' ARTICLE ON "EFFICIENCIES IN WIRELESS TELEGRAPHY."

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imagined for the sake of the definition are despatched from the same antenna with the same average energy-rate as the damped waves under examination.

The energy absorbed by the receiving antenna is now in part passed across the coupling coils to the detector; but only in part, for some of it is dissipated by the antenna resistance. Here again the total amount of resistance can be divided into two parts—radiation resistance and ohmic resistance; that is to say, some of the energy is re-radiated, and some of it is dissipated in joulean waste. It is precisely because some of it is re-radiated that the well-known law arises that the absorbing power of an antenna is proportional to its radiating power. Here again an efficiency might be introduced, but it is good enough to repeat the mode of treatment already adopted, in the analogous question connected with the transmitting process. That is, we lump together all the processes intervening between the absorption of the energy from the waves and the delivery of the energy to the detector, and we define the EFFICIENCY OF THE ANTENNA AND ITS ASSOCIATED RECEIVING CIRCUITS as the ratio:

$$\frac{\text{Rate of energy-delivery to the detector}}{\text{Rate of energy-absorption from the waves}}$$

Although we have not yet finished the list of efficiencies to be considered, it is well to pause in order to notice a convenient coefficient which arises if we look broadly at the whole process of the transmission of energy from the transformer-secondary to the terminals to the detector. This coefficient may be called the OVER-ALL HIGH-FREQUENCY EFFICIENCY. It includes efficiency of generation of oscillations, the radiation efficiency of antenna, the efficiency of propagation, the resonance efficiency, and the efficiency of the antenna and its associated receiving circuits; and it is, in fact, the continued product of all five.

To resume, we know that the energy delivered in the form of oscillations at the detector terminals is converted by the physical processes of the detector into direct current, which passes to the telephones. The proportion converted is, of course, called the DETECTOR EFFICIENCY. In the telephones this direct current produces sound, which affects the ear of the operator. This is the last purely mechanical link in the long chain of transformations of energy involved in wireless signalling. We may define the EFFICIENCY OF THE TELEPHONE RECEIVER as the ratio:

$$\frac{\text{Rate of energy-emission as sound}}{\text{Rate of energy-delivery to telephones}}$$

The magnitude of this efficiency depends, of course, both on the construction of the telephones and on the character of the pulses which it receives. Last of all, we have to take into account the magnitude of the sensation produced in the telegraph-operator's brain, as a proportion of the energy of the sound-waves from the vibrating diaphragm of the telephone. This is a physiological matter, and all we need notice about it is that this efficiency depends greatly on the pitch of the note used in musical sparks, and, of course, also on the average keenness of hearing of the operator.

The efficiency coefficients briefly sketched and defined above must now be discussed *seriatim*. To many of them values may roughly be assigned which are different for different systems of wireless telegraphy; and in this way we may gain a notion of some of the points of strength and weakness of the various systems.

It is necessary to point out, however—and the reader ought to keep in mind the fact—that mere efficiency is not a dominating criterion of the practical or even economic value of a system. It might happen, for instance, that a system which was very efficient in our sense of the word would be very inconvenient or slow in operation, or might be expensive in installation and in renewals.

(*To be continued.*)

The Compagnie de Télégraphie Sans Fil, in Brussels, has just been transformed, and under its new shape will in future be known as "Société Anonyme Internationale de Télégraphie Sans Fil."

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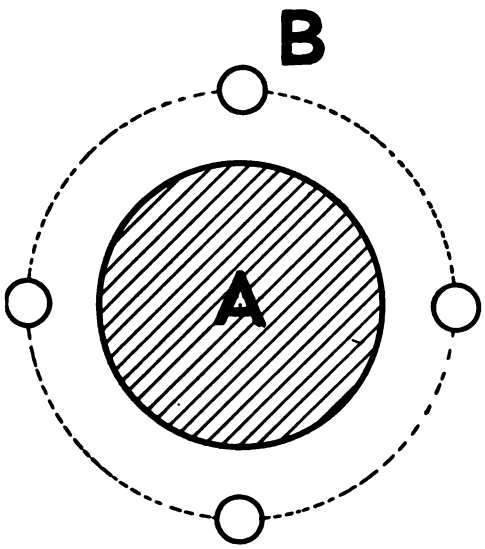
The Molecular Structure of Insulators

By H. M. DOWSET

The Author examines the molecular structure of certain insulators with a view of determining the properties of insulation of such substances as mica, porcelain or ebonite.

THE average electrical engineer looks upon a piece of mica, porcelain or ebonite with a certain amount of friendly respect, for they are insulators, whereas he is a conductor, and many a time they may have stood between him and a coroner's inquest. But as a rule he knows very little about them. What gives these substances the property of insulation?



We may find an answer to this question if we examine their molecular structure.

In the course of a series of very interesting lectures recently delivered at the Royal Institution, Sir J. J. Thomson described the atom as consisting of a spherical positive nucleus A, surrounded by a moving belt of equally spaced free electrons or negative charges B. It is the motion of these free electrons which constitutes an electric current, and conductivity is the property of transferring them from one atom to another.

In a good insulator, therefore, this interchange does not take place.

The atoms of the inactive gases, Helium, Neon, Argon, Krypton and Xenon, are not supposed to have any free electrons, but all other insulating elements have either (1) a very tight hold of them, or (2) the atoms are well spaced apart so that their mutual action tending to free each other's electrons is weak.

Sulphur is an example of the first class. In its amorphous state with its atoms fairly close together it has a resistivity of 4×10^{15} or 2×10^{21} that of copper. This figure is so large that if it were not for its chemical activity one would be inclined to think that sulphur could have no free electrons.

Selenium is similar to sulphur. Measured in the dark, its resistivity is 2×10^{16} or 10^{22} that of copper.

The vapours of the good conducting metals and all gases are examples of the second class. They are all insulators.

Atomic Groupings.

If now we consider the effects of atomic groupings on insulation, we have to note that the free electrons in the molecule of a simple element, or in the molecule of a compound, are supposed to be the chemical bonds which hold the atoms together. They are therefore less free in this state, and for this reason the molecule is a better insulator than the atom.

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In fact, conductivity in liquids and gases involves a breaking up of the molecules before it can take place.

We next pass to molecular groupings. The molecules may either assemble, each one independent of the other, when the substance is said to be amorphous, or they may assemble in a number of independent groups, or they may all pack close together, each one as it were gearing into the other. The substance then is crystalline and has a definite structure.

Although there are many good insulators, such as mica and quartz, which have a structure, the structureless state, indicating molecular independence, is essentially that which gives best insulation.

When sulphur is changed from the amorphous to the crystalline state its insulation falls.

The change is much more marked with silicon. As an amorphous brown powder it is a good insulator, but the steel grey crystals are conductors.

Again, selenium in the dark is an insulator, but when exposed to light it receives a structure, and becomes a conductor.

One of the best insulating materials is glass. The whole aim of its manufacture is to ensure that it shall be structureless. Glass is composed of a number of substances which are not chemically combined, but are in mutual solution. Ordinary window glass, for instance, consists of sand, limestone, salt cake, and a few auxiliary substances, silica and lime predominating.

In Liquid Solution.

Now, in a liquid solution the molecules of the different substances diffuse evenly all through the volume as in a gas. Each molecule is as well separated from molecules of its own kind as it can possibly be, and there is no structure. Such is the case when glass is molten. The whole effort of the manufacturer is to retain this state when the glass solidifies.

As the temperature of the liquid falls, one constituent tends to solidify before another, as their freezing points are not all the same. This tendency must be checked, otherwise the material becomes crystalline.

The manufacturer, therefore, at a certain stage of cooling chills the solution rapidly, so that the particles of those substances which solidify first have no time to move together through the resistance of the liquid before the whole is solidified.

The congealed solid, therefore, has its molecules in the same relative position as when the material was in the liquid state. It remains a perfect mixture, and it is this discontinuity of similar substance which is principally responsible for its high insulation.

Glass can be made from a large variety of substances. Even the best conducting elements can enter into its composition and contribute to the production of a good insulator, simply due to the way their molecules are arranged in the material.

The different kinds of glass naturally show different degrees of insulation, according to the resistivities of the elements composing them. Those containing silica and lime are the best, having a maximum resistivity of 2×10^{14}, while those containing lead or alkali are the worst. What is known as conducting glass is very rich in alkali, and has a resistivity of 10^8, that is 2×10^{14} as much as copper, so that it is still very much of an insulator.

Glass may either be cast in moulds, rolled, whirled into discs or blown into cylinders. The cylinders may later on be cut, opened out and annealed into flat plates. It is the blowing process, as we should expect, which produces the best insulator, for this method strains the material until the molecules very nearly part company.

Pitch, rubber, ebonite and porcelain are other examples of insulators whose molecules show various degrees of independence in their arrangements. Pitch is an extremely viscous fluid—structureless, like glass.

Caoutchouc or rubber, in the raw state, consists of minute transparent globules, about 1/25,000th inch in diameter, suspended in the sap of various trees and shrubs.

Caoutchouc.

In all the processes which the caoutchouc goes through from the raw state to the finished article, the coagulation and drying of the sap, the cutting up, crushing, heating and kneading of the raw rubber, the essential character of the self-contained caoutchouc globules is maintained. This structural independence of the units results in a want of structure in the aggregate, which tends to produce a good insulator.

When rubber is vulcanised by treating with sulphur, the sulphur appears to enter

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into the substance of the globules without breaking them down.

Sulphur melts at 115° C. Vulcanising begins to take place at 140° C., and is carried on to 150° C. This is below the temperature at which the caoutchouc globules break down and run into a liquid, namely 200° C. As the sulphur combines with each globule independently, when used in small quantities it does not alter very much the general character of the physical properties of the rubber. It increases the strength, flexibility and insulation. Excess of sulphur results in the hard, black insulating material, ebonite. The resistivity of rubber is about 2×10^9, and of ebonite about 2×10^{15}.

The native rocks furnish another example. Limestone, white marble and iceland spar have all the same chemical composition. The first named is an amorphous rock, the second has every grain a crystal, and iceland spar is found in large crystals. They rank as insulators in the order named, the order of structural development. Marble has a resistivity of 7×10^{14}, which is about one-tenth that of limestone, and twice that of iceland spar.

In conclusion we may explain why the diamond offers an interesting exception to the general rule as regards structure.

An octahedral crystal, it is a good insulator. Heated in an electric arc, it swells up and takes the appearance of coke. It becomes a structureless solid with more space between its molecules than before, and yet it is changed into a good conductor. The reason is this:

The effect of heat is to weaken the hold of the atom on its free electrons. The diamond has been formed under intense heat and intense pressure.

The tendency of the former is to rob the carbon of its free electrons, and of the latter to induce a more intimate cohesion between its atoms owing to the absence of these electrons than could be obtained before. This greater cohesion, however, avails nothing as regards conductivity, owing to the want of electrons to conduct, but it is so strong that it requires the energy of excessive heat—heat from a Bunsen burner is not enough—before they part company, and take back the normal number of electrons to their respective orbits.

LOCAL ABSORPTION IN "WIRELESS."

Writing in the *Electrical World*, Mr. A. H. Taylor describes some experiments on this subject, from which he draws certain conclusions which are of particular interest to amateurs and others who have to deal with small-power working. By "local absorption" he refers to certain phenomena caused by purely local conditions at the sending or receiving stations, these being kept distinct from the phenomena of "general" absorption of electromagnetic waves by the medium traversed, which—from the results obtained by Austin at sea—the writer does not consider of serious importance for short distance working unless very short wave-lengths are employed.

The local effects to which he refers include those produced by the proximity of power-, lighting-, and telephone- and telegraph-circuits, and of grounded conductors, such as gas, steam, and water pipes. He mentions that in certain experiments it was found at the transmitting end that a particular wave-length set up serious surges in the lighting-circuits of the building, though these circuits had no connection with the "wireless" power-leads. These surges made themselves evident by the burning-out of several tungsten lamps, and though—when thus noticed—they were obviated by altering the free oscillations of the lighting-circuit by putting two one-microfarad condensers across the lines at two points found by trial, the writer points out that it would be quite possible for a considerable amount of aerial-energy to be absorbed and wasted in this way without attention being called to it. Moreover, the same waste might easily occur in the neighbourhood of aerials used for reception only. Further experiments are described, in one of which it was brought out that in some cases the presence of insulated overhead circuits may be beneficial to reception on small aerials near to such circuits. In general, however, such circuits would absorb energy and would not re-radiate it to the aerial. In a building containing grounded circuits the writer concludes that it is best to locate the receiving apparatus as *high* as possible in the building. Referring to the large condensers used for protecting the circuits, as above-described, the writer wisely recommends that they should be provided with fuses to prevent short-circuit in the event of a puncture.

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The War Office Committee on Wireless Telegraphy

AS already reported, a committee was appointed by the War Office in August of last year to consider recent developments in wireless telegraphy and telephony, more especially with reference to the desirability of their extended application for military uses in the field. The integral part of the enquiry was the determination of the particular system most suitable for the requirements of the British Army, and in this connection a visit to the Marconi works at Chelmsford by members of the Commission was arranged for April 8th, 1913. The members of the Committee who were visitors on this occasion were Sir Henry Norman, M.P., Chairman of the Committee, Major R. H. Boys, D.S.O., R.E., Mr. E. Russell Clarke, Col. R. D. Whigham, D.S.O., of the General Staff, Col. Hippisley, and Capt. Louis Vaughan, Secretary of the Committee.

The first item was the erection of the three different types of portable masts, which are respectively 105 ft., 70 ft. and 30 ft. high. After this an aerial was attached to one of the masts and to the cart station in the marquee erected for the purpose. The Committee then inspected the stations, trying the engine, and examining the apparatus. These stations are of ½ kw. and 1½ kw., the former having a guaranteed range of 35 miles over normally flat country. The apparatus is carried on two two-wheeled carriages, the total weight of each carriage being, when ready for transport, about 600 lbs. They are so arranged that they can either be drawn separately by hand or limbered together and drawn by one or two horses. But in case of necessity where, for instance, wheeled transport becomes impossible, the station can be quickly dismounted and the apparatus divided up into a number of smaller loads which can be carried by hand. The heaviest of such packages is about 85 lbs., and the best method of hand transport is to sling each load on a mast section, which can then be carried between two men. The total number of such loads for each station is eight. The staff usually required to manipulate such a station is four, though it can, if necessity compels, be erected and worked by a minimum of two. The station can be erected within ten minutes.

The 1½-kw. station is of much greater range, and elaboration. The *personnel* for such station is at eight men, but here again in times of necessity it can be easily worked by three, nor does it take much longer to erect than the ½-kw. station —twenty minutes being a good outside time limit. The masts are two, each 70 ft. in height, supported on a horizontal antenna. The generating set is a two-cylinder, eight horse-power, air-cooled, petrol engine, driving a high-frequency 1½-kw. self-exciting alternator. The transmitting wave-length is reckoned between 700 and 1,300 metres, and the receiving wave-length between 450 and 1,400.

The 1½-kw. motor-car station was then very carefully examined. This is similar in construction to the type just described, except that here the whole of the transmitting and receiving apparatus, including the generating group, is conveniently fitted up in the body of the car, while the trailer which accompanies the car carries the two masts with their derricks and earth gear.

After this an inspection was made of the various small parts of the engines, which were laid out for examination.

Following this the Committee adjourned to the test room to inspect the 3-kw. set which has been commissioned by the Italian Government, and which at the moment was undergoing the preliminary tests. Lunch was then served, and the opportunity was taken to send the motor-car station up to Broomfield in order that a test might be made of the clearness and tune of the signals received therefrom. After this the Committee made a tour of the works and saw the various parts of the field station in the course of manufacture.

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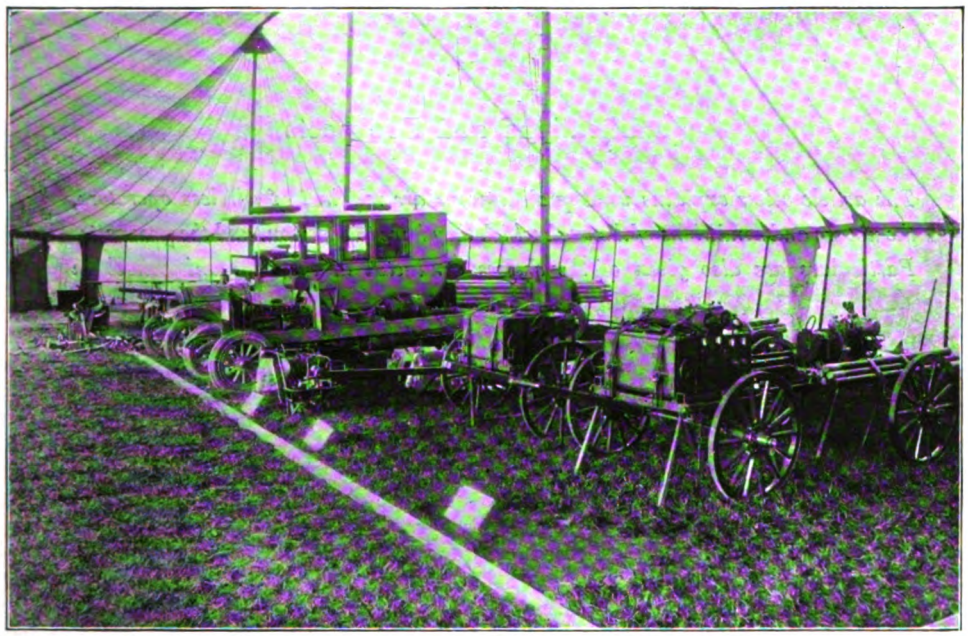
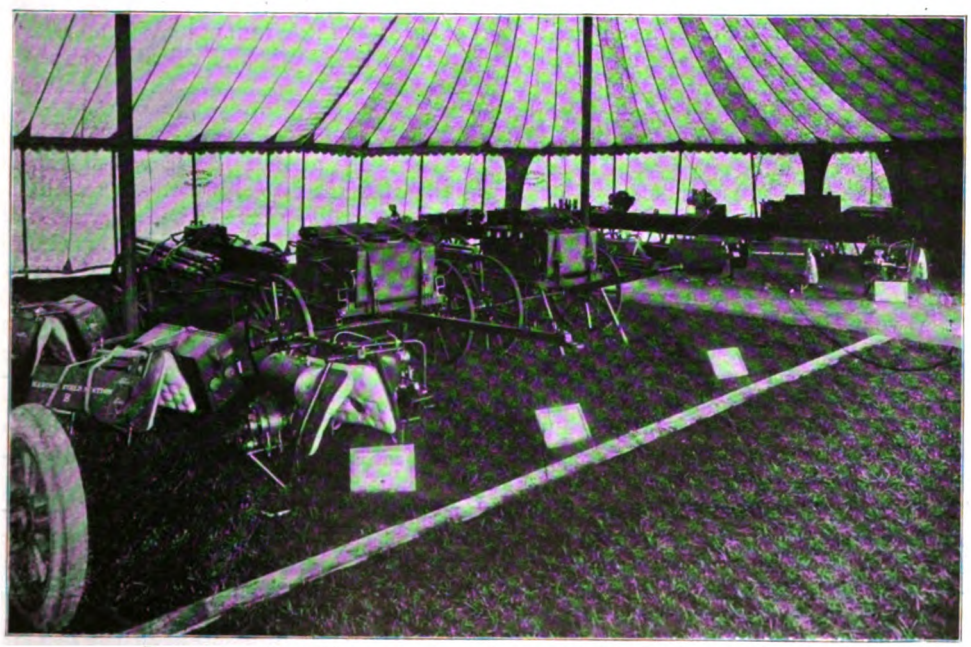
Arrangement of Portable Field Stations for War Office Committee at the Marconi Works



From left to right: 1·5-kw Motor Car Station; Chassis for 1·5 Motor Car Station, showing generator and drive; two types of ·5-kw. Landing Stations



The ·5-kw. Pack Station is shown to the left of the Landing Stations

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The Wireless Operator

Qualifications and Prospects

The article below explains what qualifications are required of wireless operators, the nature and conditions of the work which they have to carry on, and the prospects. Particulars are also given of the classes conducted at the Marconi School in London.

"WHAT is your boy going to be?" Every father knows the question that is fired at him from all sides when his son is about to leave school; knows, too, the worry it causes him. Scarcely having given a serious thought to the matter before, he commences to button-hole his friends and ask their "personal experience" of this or that business or profession. He receives cold comfort. Every field, he finds, is overcrowded. The Bar, Medicine, Engineering—they all mean a long apprenticeship or heavy premiums and the unalluring prospect of the lad having to lead the "simple life" or of being dependent on his parents for years after he makes his first entry into the salary-earning arena. Dismayed at the barrier that confronts him the parent begins dismally to study books on what to do with our offspring, and ends by becoming thoroughly pessimistic.

PROSPECTS OF THE SERVICE.

Yet there is one profession which is not overcrowded—one which will appeal strongly to the young man of mechanical bent. To enter upon it necessitates no lengthy and costly training, neither does it mean months of weary waiting for a situation when that training is completed. Above all it offers, what every young man of spirit desires, independence of financial assistance from his parents the moment his training is completed.

Springing into existence when wireless telegraphy was recognised to have a commercial application, the new career—that of wireless operator—made an instant appeal to hundreds of young men throughout the country. Thousands of others were vaguely interested in it, but hesitated to embark on a career that the pessimists croaked "would not last."

In the face of the pessimists wireless telegraphy has made progress in every quarter of the globe. Hundreds of land stations exist, and a glance at Lloyd's Register shows that thousands of vessels are fitted with the new invention. Even so, radiotelegraphy is barely out of its cradle. Every week sees a new land station in the course of erection; every month, as the pages of THE WIRELESS WORLD show, reveals a lengthy list of ships in course of fitment.

AND THE DUTIES.

The life of a wireless man runs on agreeable lines. If drafted to a passenger vessel the operator usually takes the honorary rank of a junior officer. Signing the ship's articles as a member of the crew he is, of course, subject to the disciplinary regulations of the ship—a terrible-looking official phrase which implies no more restriction than he would be subjected to in any business house. He receives a wage that compares favourably with that paid to telegraphists in the home Government and cable services and substantially in advance of and increasing more rapidly than that paid to railway telegraphists. His hours, where two operators are employed, are regular, but where he is in sole charge long and irregular hours will occasionally be his lot.

The wireless man is not expected to be a

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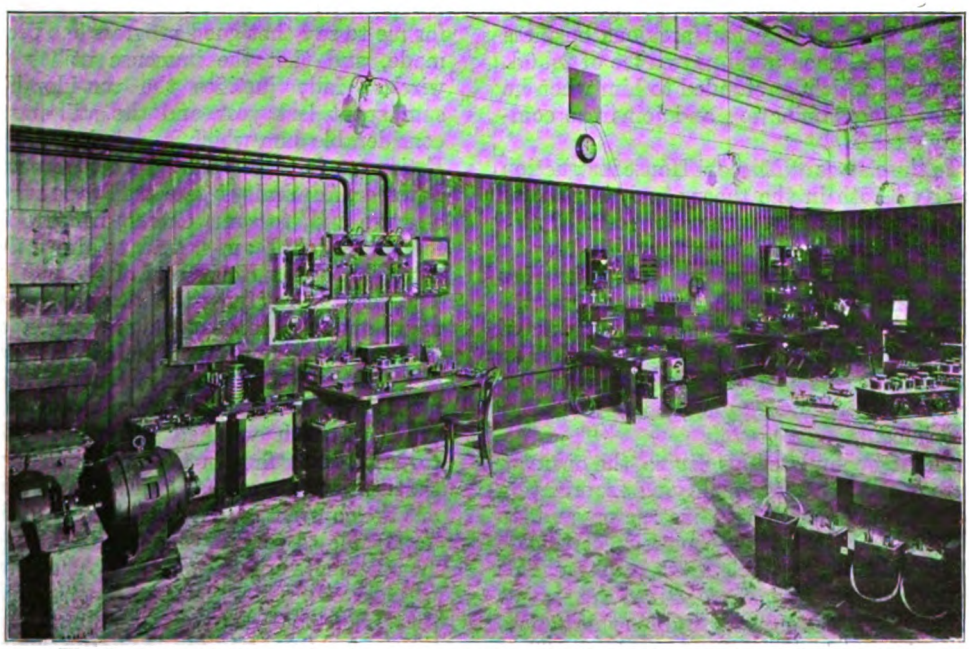
Views of the School for Operators at Marconi House, London, where day and evening classes are carried on.

Training Wireless Telegraph Operators at Marconi House



***The Instrument** Room, showing (from left to right) a 5-kw. Station, ½-kw. Station, and 1½-kw. Station*

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prodigy. Entering on his career between the age of 19 and 24, a pretty sound general knowledge, clear handwriting, and the " wit to learn " are essential. If he knows anything of electricity and magnetism, of foreign languages, or of telegraphic work, he will have everything in his favour.

On entering their new premises in the Strand last May Marconi's Wireless Telegraph Co., Ltd., established a school in the building for the training of wireless telegraphy operators. The classes proved so popular that it became imperative that the accommodation, which had been limited for 60 students at day and evening classes, should be immediately increased. Last month, therefore, the school was transferred from the top of Marconi House to the basement, where accommodation is now found for 125 students.

Three distinct classes are held in the school. The day class is for students who have generally had some previous land line or cable telegraphic experience, and serve about two months on trial as learners in order to acquire a working knowledge of the Marconi system of wireless telegraphy.

The evening classes, which are held three evenings a week, from 7.30 p.m. to 10 p.m., are open to students between the ages of 19 and 24 who have had previous business experience. Each pupil pays a fee of 2s. 6d. per week, which is refunded to him when he passes the examination and joins the company's staff.

In the classes at Marconi House instruction is given both in the theory and practice of wireless telegraphy. The beginner is first taken through an elementary course in magnetism and electricity. When familiar with the theory he is instructed in the sending and receiving of signals by means of the Morse sounder, buzzer and telephones. Later he learns how to adjust apparatus, to trace and remove faults, and to repair breakdowns.

Having completed his course, the operator is required to pass a qualifying examination set by the Company's instructor and to obtain the Postmaster-General's certificate of proficiency in wireless telegraphy. This done the operator is drafted into the service of the Marconi Company and his tuition fees are returned to him. No fewer than 130 of the students of the classes have passed the Postmaster-General's examination since the opening of the London school in June, 1912, and have obtained employment in the Company's service. The Company's school at Liverpool has been in existence since 1903, and a large number of students have passed through it into the Company's service.

A word in conclusion about the prospects. The operator starts as a junior and gains promotion to the rank of senior. After a term at sea, he may qualify for a shore appointment or for a travelling inspectorship, with special pay. If he fits himself for it, a position on the engineering staff of the Company may be his. The steadily increasing adoption of radiotelegraphy is from time to time opening up valuable appointments in many parts of the world, not only on land, but on warships, yachts, and even airships.

THE ADMIRALTY AND WIRELESS.—In the course of his speech in introducing the Navy Estimates in the House of Commons on March 26th, Mr. Winston Churchill, the First Lord of the Admiralty, made the following statement:

> The development of wireless telegraphy in seagoing ships and in the shore stations of the Admiralty has during the year been very satisfactory. All the details are strictly confidential, and it is sufficient for me to say that good progress has been made, and that the immense utility of wireless fully justifies the considerable sum spent last year and the still more considerable sum which is included in the Estimates for this year. In one respect, however, Admiralty interests have suffered a grave and, to some extent, irreparable loss to which I am bound to draw the attention of the House and of the public. The delay in ratifying the Marconi agreement and the consequent prevention of all progress in the Imperial chain of wireless stations has deprived us of the advantages in regard to wave-length and priority which we had hoped to gain through being first in the field, and now that the company has refused to carry out the contract, and since it is manifestly impossible to compel them to do so, new arrangements of a different character will have to be devised, and it is possible that additional charges will be incurred by the public. No step, however, which will now be taken can put us back into the position which has been lost.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

Charles Summers, the only son of the Vicar of Sotheby, is an engineer and inventor, His peculiarities arouse comment among the villagers, and his workshop is the subject of so much curious speculation that Doss and Suk, two itinerant pedlars, make it their business to discover its secrets.

CHAPTER I.

INTRODUCTORY.

"PARSON SUMMERS ha' gotten a rum 'un."

A pause.

"I reckon that young man be nobbut a fule."

Another pause.

The speakers were lounging outside the principal inn of Sotheby, a village not far distant from the important country town of Chittingham. They were evidently characters of the place, the one a man, the other a woman; but it was only by the clothes they wore that the sex of either was to be distinguished. Both were old, though there was nothing to indicate the exact number of their years. They were burnt copper colour by exposure to sun and rain, their faces were wrinkled like the dry kernels of hazel nuts, and their gipsy appearance was enhanced by a grime of long standing which engraved itself in the heavy wrinkles lining these two faces. Both, too, were sucking short clay pipes as tanned as their owners—that is to say, as much of the pipes as was visible, for the stems had been worn away by constant use, and only the bowls protruded from between the smokers' lips.

Doss and Suk were brother and sister, pedlars by profession, and vagabonds by inclination. Year in and year out they were to be found in the neighbourhood, hawking unconsidered trifles of ribbons, bootlaces, buttons, screws and all the impedimenta of a country Autolycus. Who were their parents nobody knew, nor indeed had anyone heard them mention the name of a single kinsman. They seemed to be derelicts thrown up on the country side, and not even the longest memory in the village could remember them in any other conditions or under any other circumstances. They had no home, and where they slept was equally a mystery with their parentage. A barn or loft or some broken-down shed served to shelter them no doubt during the wintry nights, and a hayrick or the hedgerow, or even the open field, was sufficient for their needs in summer. Only once had either of them been ill, and on that occasion it was Suk, who had sunk down on the floor of the very inn where they were now sitting, overcome with ague, which later had developed into pleurisy. She was taken off to the village hospital, and for weeks her life was in danger. All through the period of her illness her brother wandered disconsolately about the village, a solitary and unkempt figure, neither speaking to anyone nor welcoming the approaches of compassionate neighbours. Each evening he would inquire at the hospital for news of his sister, and on receiving it would slink back again into the darkness of unfrequented paths, only to return on the morrow to make the same inquiries and go his way again. When at last his sister was discharged, the pair of them departed from Sotheby, nor did they return till Suk's white face was once more as begrimed and brown and withered as her brother's, and they were to be seen as of old, carrying their pedlar's packs and journeying from cottage to cottage to sell their wares, or tell the fortunes of their more credulous clients.

Now it was late autumn, and the two had

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been taking their usual glass of ale at the conclusion of the day's work. It was not late enough for the farm labourers' return om work, and they were alone, sitting on the bench outside the "Albion Arms." For the best part of an hour they had sat there when their silence was broken by the words which open this chapter. Doss was the first speaker, and his sister's reply shows the difference in their characters. The little femininity that remained with her gave her a sharper outlook on life and a more acrimonious tone. Whoever she could not understand was "a fule," and she had but expressed the general opinion of Sotheby's women kind when she applied this epithet to Parson Summers' son. Her unequivocal verdict had nearly put an end to the conversation, if such it could be termed, for it required a supreme effort of thought on Doss's part to break down so decisive a statement and continue the discussion with his companion. After another long spell of silence he spat on the ground and remarked:

"Mebbe he's a fule, but he is a larned fule. Only yester' mornin' I was a-sellin' a comb to Bettie—she be Parson's new maid—when he cum'd out of his workshop. Such a moither yer never did see! His hands were black as ole Tinker Bill's, and the Almighty alone knows what he had been a-doing, such a buzzin' and wuzzin' inside that shed as if a whole skip of bees had a-been swaarming."

He stopped, and was meditatively taking the pipe out of his mouth to knock out the ash, when his eye caught sight of a slim figure turning down the bend of the road opposite. The pipe remained unemptied, for Doss, seizing the worn bowl in his hands, pointed with the stem at the figure.

"Thar goes!"

Doss looked up sharply and craned forward so as not to lose any of the excitement caused by the passer-by. Without a doubt it was Charles Summers taking his short evening walk. At his heels was the white and black spaniel which always accompanied his master on these occasions. The figure was that of a young man, tall and slight, with a rather pronounced stoop, accentuated at the moment by his thoughtful attitude, as he looked blindly ahead, his eye fixed on some imaginary spot a few yards in front of him. His hands were clutching the tails of his coat, pulling it down from his shoulders, and giving him an odd appearance, which helped to substantiate the verdict of Suk. Doss, as he pointed him out, raised his voice above his usual guttural monotone, and this caused the innkeeper and his wife to come to the door. At the same time one or two of the usual evening customers strolled up, and it was not long before the knot of villagers with the pedlars in the centre were discussing the merits and demerits of the Parson's son. He was a main topic of conversation in the village, for ever since a child his aloofness had been the occasion of gossip, and now that his engagement to Mr. Thrale's daughter had become known he had more than ever formed the basis of Sotheby's conversation.

Summers was unconscious of all this, as he made his way along the village street and turned up at last into a bye lane leading out into the open country. He was engrossed in an engineering problem that he had set himself to solve. Figures and equations jerked like demons on his mental horizon, and would not solve themselves into the regular battalions which obey the laws of mathematics. At last he gave up the struggle, and allowed himself to drift into lighter fancies. His thoughts went back to his childhood—not so very far back, perhaps, if time is to be counted by length of years, but to him who had crowded as much into his thirty odd summers as circumstances would permit, it seemed to him to be very distant now. He was the only son of a kindly, indulgent, easy-going father, who had humoured him in all his caprices, and from whom he had inherited an intellect above the ordinary. But it was to his mother that Summers owed his force of character, and it was this force which bade him forego the path of least resistance—that is to say, the comfortable existence of a country life—and compete for an existence, it might be a prize, in the crowded profession of engineering. His ambition had all been that way. As a little boy it had shown itself in an inordinate love of trains and mechanical toys; later it had urged him, when he might have been birds' nesting or fishing, to make long tramps towards Chittingham, and sit for hours on a five-barred gate where he could watch the trains steaming into the junction, his notebook and

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pencil ready to take down the names and numbers of the engines and note details of valve gears, or working pressures, or wheel arrangements. Then had come school life and its manifold interests, when cogs and nuts and rivets and springs had to be put aside, except in the leisure hour, and he had to apply himself to the mastering of Latin and Greek and their dread intricacies, with only school-boy games to vary the monotony of this irksome work. At that time his one solace and El-Dorado was his locker—and what a locker it was! A tool chest, a laboratory and a factory, all in one. It was well that the careful headmaster never had a chance of peeping inside it, for had he done so, he would have had no option but to confiscate the entire contents in the interests of public safety. In fact, it was only a magnificent Providence that averted disaster, for pyeric acid hobnobbed with tin filings, phosphorus and magnesium wire and mercury were in dangerous proximity the one to the other, while the whole was buried in an indescribable confusion of springs and gimlets and copper wire, and the other appurtenances of the engineer.

But young Summers' classical training did not last for long. After the Rev. Edward Summers had gleaned as a harvest for good money lavishly expended a series of reports which the most optimistic could not but construe as depressing, and which, as the years advanced, grew more and more lugubrious in tone, the fact was at length borne in upon him that his son was not fitted for a classical or scholastic career, and that further efforts in this direction were likely to result in failure. In accordance, therefore, with his generous principle of *laissez faire* (but under the circumstances he must be considered to have acted wisely), he allowed his son to take up engineering, and entered him as a student of a technical college. He was rewarded by his son's greater happiness, and if not brilliant, at least solid success.

These were the days which Summers was thinking of at this moment, and a smile enlivened his somewhat phlegmatic face as his thoughts passed from one episode to another in his career. He was now walking swiftly, his steps according with his mental activity, but he was still entirely unconscious of his surroundings. Gyp, the spaniel, was allowed to scamper along unheeded, his nose close to the ground as he foraged in the hedgerow for anything that might turn up, while now and again he would dart through the hedge and shuffle breathlessly after some hare which he had disturbed in his exploration. Suddenly Summers came to a standstill. In his cogitation he had hit upon an episode which gave him a clue towards the solution of his present difficulty. Yes, it was quite clear he could get the effect he wanted by using that old formula. He breathed a great sigh of relief and looked around him. His whole attitude changed. With re-awakened energy he shook himself as though to get rid of his premeditation. A sharp whistle, and Gyp was at his side; then with a "Cheeroh, mannikin!" to his faithful ally, he started for a run across the hills, and returned home as the evening closed in, breathless and refreshed, and, by one more difficulty solved, a younger man.

CHAPTER II.

THE "DEVIL'S SMITHY."

The following morning found Charles Summers eagerly engaged in his workshop. It was a Saturday, the most important day of the week for him. As a parson's son, and that parson vicar of the neighbourhood, he could not count Sunday in his reckoning, for there were services which demanded his presence, and primitive village prejudices which had to be considered, to say nothing of a standing engagement to tea at Thrale Hall. On Saturdays, however, the case was different. The firm which engaged his services as an engineer, and which had extensive works for electrical appliances at Chittingham, dispensed with those services for the last day of the week, and this gave Summers an opportunity for working out ideas which an oftentimes leisurely week allowed him to develop in his fertile brain. On this particular day he had been up when the morning was still young, and before breakfast was ready had done sufficient work to make an ordinary navvy wish himself dead. Fortunately for the inmates of the Vicarage, his workshop was situated at some distance from the house; otherwise their matutinal slumbers would often have been disturbed by hideous noises, as for instance a series of filings as would have set all their teeth on edge, or perhaps the

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roar of a Bunsen burner as the operator pedalled the bellows and worked glass tubes into most intricate and gordian knots, or blew it out into globes of crystallised fire. Not that all Summers' work was of a noisy description. He would spend hours upon hours manipulating delicate machinery and making adjustments with particles of wire and silver and platinum. Even jewels came into the scheme of workmanship, and all this was labour so delicate that the mending of a butterfly's wing would have been a clumsy employment compared to it. Then, too, there were the diagrams, which he often had to work out—sheets and sheets of them, which, if one had opened the doors of an ancient press standing in one corner of his room, would have been found heaped together in indescribable confusion. Nor did the press contain them all; they were jabbed on nails sticking out from the rows of dusty shelves, they littered the table in front of the big window, and a variety of drawing boards stacked one against the other behind the door were covered with similar expanses of fair white linen marked with dismal complications of faint blue lines. But there was one part of the room which was in striking contrast to the disorder of its general arrangement. This was a large recess containing a table of polished oak, and lit by a skylight which at this time was shuttered by dark blue curtains drawn closely across. There was nothing remarkable about the table. Except for a wide margin, it was entirely occupied by a polished oak chest reaching up to the average height of a man. It seemed to be inviolate, with not so much as a speck of dust or a sign of use, and might have been some altar set up to an unknown god that no one dare approach or lay profane fingers upon. The covered chest in the centre evidently contained something peculiarly precious, which was evidenced by the fact that it had twin nickel locks of a design out of the ordinary, even in this age of cunning locksmiths. But the chest, remarkable enough in itself, was insignificant compared with the model swung above it; from it were stretched flexible wires reaching to either wall of the recess, and securely fastened to hooks provided for that purpose. It was a model of an airship, with the envelope already inflated. From appearances the balloon was made of goldbeater's skin, and very lovely it looked, like some semi-transparent bubble poised half-way between floor and ceiling. From it swung, by fine steel wires, a small ribbed car, brilliant in appearance and perfect in workmanship. The narrow steel bands forming the body of this car were plaited together, the ends of each being welded together over a narrow elliptical steel ring, somewhat pointed at either end, and projecting beyond the balloon itself. To the casual observer the model was just nothing more than a variation of the ordinary type of airship. But there was one thing which even he would have noticed as out of the common. This was a special apparatus fixed to the prow—a cylindrical nickel tube curved back from the pointed end and surmounted at the top a large nickel knob, from which projected two long narrow funnels. They looked for all the world like the horns of some gigantic snail, except that they stared out in a fixed, defiant way very different from the nervous retractile organs of a mollusk. But there were other apparatus than that which formed the distinguishing furniture of the recess. Beneath the table was a large oblong box. It might have been a locker or a tool chest so far as could be judged from outside appearances, but a handle to the door betokened that it was a cupboard. If it had been opened it would have disclosed an imposing array of electrical apparatus—a spark discharger, a half-plate condenser, coils of heavy insulated wire, an arrester terminal, could easily have been distinguished, while below the broad shelf was fixed a ship's dynamo. This was enough to show the nature of the apparatus. It was nothing more nor less than a wireless installation, and the whole locker a silencer cabin, such as is used on board ship. To confirm this theory it was only necessary to draw back the blue curtains from the skylight, and above were visible the aerials and masts which, to the uninitiated, form always the outward and visible sign of the invisible spirit of radiotelegraphy. Summers himself was now concentrating all his attention on this wonderful toy. Nervously he pulled the cords and drew back the blue curtains to let in the autumn sun. Then as a precaution he carefully washed his hands, and proceeded to unlock the chest, using a key

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fixed to his watch chain. Still with infinite care he removed the cover of the chest, and there in front of him was a medley of apparatus that for perplexity was sufficient to bring dismay to the heart of any but the daring inventor. Putting the cover down by the side of the table, he sat himself before his wonderful instrument, examining it with a critical eye as he adjusted first this wire, then that, or polished the units of the intricacy. Presently he touched a lever, and the whole apparatus underwent a swift change. It might have been that a wizard had used his spell, and from chaos had created a fairy city of ivory palaces and ebony citadels, laid out in perfect precision and geometrical design. Now the complicated jumble of pegs and cubes and wires was spread over the table to form a keyboard —not unlike a backgammon-table, or even it might be compared to the keyboard of a whimsical piano wherein all the flat notes were black, and the sharps, following a zig-zag course entirely their own, were white. Besides this was another kind of note. Little brass knobs dotted here, there and everywhere, which seemed, and indeed were. capable of playing a tune all on their own, But Summers had no intention of practising on this wonderful instrument. To his experienced eye it was not yet complete, and he busied himself with adding yet more notes, and more white sharps and more brass knobs to the wonderful array. Long he spent bending over his treasure, fixing and refixing, making cunning rivets and attaching delicate wires, shaping the notes to fit one into the other like a Chinese puzzle, and lastly fixing the little brass knobs into sockets especially prepared for their reception. At length he desisted from the engrossing work, and rose from his stooping posture, bending backwards with his hands on his hips, to give relaxation to the strained muscles, and smiling to himself with a well-satisfied air as he looked at the labour of his hands and of his head. Finally he slightly re-adjusted the apparatus, moved the lever again so that everything tumbled back into its original muddled position, then replaced the cover, and turned the key.

After that he went to breakfast. The family were already at the table as he entered the room, that is to say if two persons could be rightly termed a family. His father was invisible behind the voluminous leaves of *The Times*, but certain long-drawn sips at his coffee and the tinkling of knife and fork on the plate advertised his presence and occupation. Miss Summers was seated exactly opposite her father. She was older than Charles, and already betrayed evidences of a religious bias, and a complacent acceptance of spinsterhood. Not that she was ugly, or thin, or angular, or wore spectacles, or had her hair brushed straight back from her forehead and drawn into a twist behind. No such eccentricities marked her out from the common run of womankind. On the contrary, she was rather good-looking, inclined to be buxom, and her fair hair was done in the acceptable mode of curls, held in place by a velvet ribbon ; but there was an indefinable air of primness, a set of the lips, and a mincing method of speaking which were sufficient to hint at her opinions and circumstances. She scarcely seemed to notice the advent of her brother, but mechanically helped him to the bacon and eggs, and, without observing the formalities of salutation, straightway commenced breakfast-table talk. There was a regular supply of correspondence to form topics of conversation, news from aunts and cousins to be retailed, and then the more immediate concerns of the neighbourhood. Charles replied in monosyllabic sentences uttered between his infinitely more important occupation of satisfying a voracious and well-deserved hunger. It was only when the third cup of coffee was found to be too hot to be sipped with any degree of comfort that he slipped further under the table and leaned back in an attitude of appreciative ease. By this time the Rev. Summers had finished all three of the leaders in his morning's paper, and had declared with much satisfaction that he disagreed with them all. He threw the paper aside, remarking that journalism was going to the dogs, and he didn't see why, after the expense of threepence and the trouble of reading, he should be treated to such a diet of wind in three spasms. As he had made a similar remark every morning for as long as his children could remember, they thought it unnecessary to make either dissent or assent, but when he passed his cup along, and joined in parochial gossip, the conversation became animated. An easy-going

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life and a cultured intelligence made him a good conversationalist, and he had the power of investing quite ordinary topics with an interest far beyond their exact merits.

By the way he remarked: "I hear those old vagabonds have once again turned up in the village."

"You mean Doss and Suk?"

"Yes, the old ragamuffins are as queer as their names. I should like to know how they came by them."

Here Charles chimed in: "In the same way that they came by their livelihood, I should think, and heaven alone knows how that is."

"Don't impute such knowledge to the heavens, my dear Charles. Popular opinion has it that the devil takes care of his own, and it strikes me that they came by their names in the same way as they came by their means of sustenance. We shall hear of a good many petty pilferings and sundry missing fowls if they stay in the neighbourhood much longer. I only hope I shall not be called upon to read the burial service over those old scamps. I shall choke when it comes to 'In sure and certain hope'; but there is one thing to be thankful for—they have no relatives to write them a lying epitaph."

"I think, father," interrupted his daughter, "that you are rather hard on the old people. You must own their lot has not fallen in a fair ground, and as far as I can make out, although their visits are productive of a terrible amount of gossip and scandal-mongery, they have never been found out in thieving or roguery."

"Yes, yes, but what did I say just now: the devil looks after his own. As for the gossip and scandal-mongery, I can tell you all about that. Yesterday I heard old Doss telling Lucy's fortune. It was the cunningest flattery one could conceive. The scoundrel tickled her palm, and babbled nonsense with a shrewd question every now and then, till he had wheedled out of her sundry silver coins, and every item of our private affairs. If I catch him hanging about these parts I shall send him about his business, and threaten him with the police. We shan't hear of him then for a good while."

"Well, I have never found him so bad. He has chopped up a good deal of wood for me at one time and another, and he works well and is respectful."

"That may be, but I wish that you would not have anything to do with him. I'm sure that old rogue breeds mischief as fast as he breeds fleas."

Here the conversation ended. There was nothing more to be said, and the three departed to their various occupations. The Rev. Summers to the construction of his sermon, in which the third article in *The Times* came in particularly handy; Miss Summers to the ordering of the household; and Charles, calling the dog, went once more to his den. Carefully locking the door behind him when he entered, he threw off his coat and lit a great meerschaum, then sat down to a lengthy calculation and the scribbling of multitudes of figures. The work perplexed him somewhat, for he tugged vigorously at the roots of his hair, and spent the larger part of a box of matches in lighting his pipe at various times. The minutes ticked swiftly away, and it was nearly noon before Gyp, who had been sleeping peacefully, roused his master from his occupation by a series of low growls. Looking up, Charles became aware of a figure shuffling by the path running underneath his window. It was the peculiar gait which made him look a second time, and then his suspicions were so much aroused that he set himself to watch subsequent manœuvres. Taking advantage of the thick laurel bushes which divided this part of the garden from the tennis court, Suk was moving this way and that, as though spying out the land. Every now and then her eyes would roam over the house, questioning each window in case she should be observed. Emboldened by her apparent security, she then crept forward some paces till sheltered by a bush larger than the rest, under cover of which she could see into the long, low window of the workshop. Then she remained attentively watching for as long as Charles was apparently engaged in his work; but suddenly he made a movement, and she saw him look up. Quickly she slunk back, retraced her steps, and before Charles had time to open his door and come out to her, she was shuffling up the path leading to the kitchen. Thinking it best not to appear suspicious, he inquired what she wanted.

"Please, sir, I've cum to sell the lasses

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their fal-lals. Mebbe they be wanting a new ribbon for Sunday, or a button hook, and I knaw they be bound to have it off old Suk than from any of your roguey drapers in Chittingham."

"But your brother only called here yesterday, and they bought all they wanted to then. Didn't he tell you?"

"Na. Doss scarcely mutters a damn to body when he's sober, but jes drinks and drinks and drinks, and arter that he doan't say nothing as what ye could understand. I never heerd that he called here yesterday. I be mortal sorry to have troubled the Vicarage again so soon, but, sir" (and here she pointed to a bare foot surrounded by what had once been a leather shoe) "bain't Miss Summers got some shoes she could give a body? These be quite worn through, for I have tramped many miles in 'em. She be a kind leddy, and mebbe she has, and she'd be doin' Gawd A'mighty service if she give 'em to a poor old body who is nigh worn out with rheumatiz."

Hospitality was the keynote of the Vicarage régime, and it would have been entirely opposed to the usual practice to have sent away a beggar without endeavouring to supply his wants. Charles went back to call his sister, and see if anything could be done for the old woman. Going up to the side door, he found it closed, and waited to ring. Instinct made him turn round, however, to find old Suk shuffling quickly up to his window, her head thrust forward as near to the glass as possible, and her keen eyes dancing as they took in every detail of the workshop. Instantly Charles called to her, and as quickly she resumed her shuffling nonchalant gait and attitude. There was no mistake as to her purpose or intention. The workshop had aroused her curiosity, and she intended to know all about it. Whether there was a deeper purpose underneath this curiosity Charles was unable to say, but it was sufficiently evident that Suk knew she was prying where she had no business to pry. This time Charles spoke roughly and told her to go about her business, at the same time hinting that if she or her brother were found loitering around the vicarage for some time to come, the police would be quickly informed of their whereabouts, and the law would give short shrift to their vagabondage.

Muttering to herself, Suk slunk round and made off as fast as her old legs could carry her, the heels of her worn-out shoes clop-clopping as she made her way down the gravel path.

(To be continued).

INSURANCE BY WIRELESS

THE successful negotiation of an insurance policy when one of the parties was in mid-ocean emphasises the value of wireless telegraphy to business men. Mr. Arthur Philips Williams, on a recent journey between Liverpool and New York by the *Mauretania*, completed a £1,000 transaction between Mid-Atlantic and London in 45 minutes. Considering the usual formalities that attend the taking out of an insurance policy, the transaction seems to have been carried out with commendable promptitude. The details of how it was done, as given by a partner of the insurance brokers concerned, are not uninstructive.

"On arriving at my office to-day," he told a newspaper representative, "I found a long wireless telegram in code from my partner, Mr. Ashley Edwards, who is on the *Mauretania*, stating that a fellow-passenger, a Mr. Arthur P. Williams, desired to insure his life for £1,000, and had completed the usual proposal form of the Commercial Union Company to that effect.

Accompanying the message was the gist of the proposal form filled in by Mr. Williams, with details as to age, etc., and the report of a medical examination by the ship's doctor.

"I got into communication with the Commercial Union Co., who, after due inquiries, instructed me to accept the proposal on their behalf, and advised me that they would 'cover' the transaction immediately.

"I despatched a 'wireless' to Mr. Ashley Edwards to this effect, and named the amount of the premium. On receipt of my message Mr. Edwards would collect the premium and hand a cover note to Mr. Williams, and from that moment he would be insured for £1,000.

"The 'wireless' from Mr. Ashley Edwards came in to my office at 10 a.m., and I sent off the acceptance message at 10.45 a.m. I understand that it would reach the *Mauretania* when the Cunarder was 800 miles out to sea."

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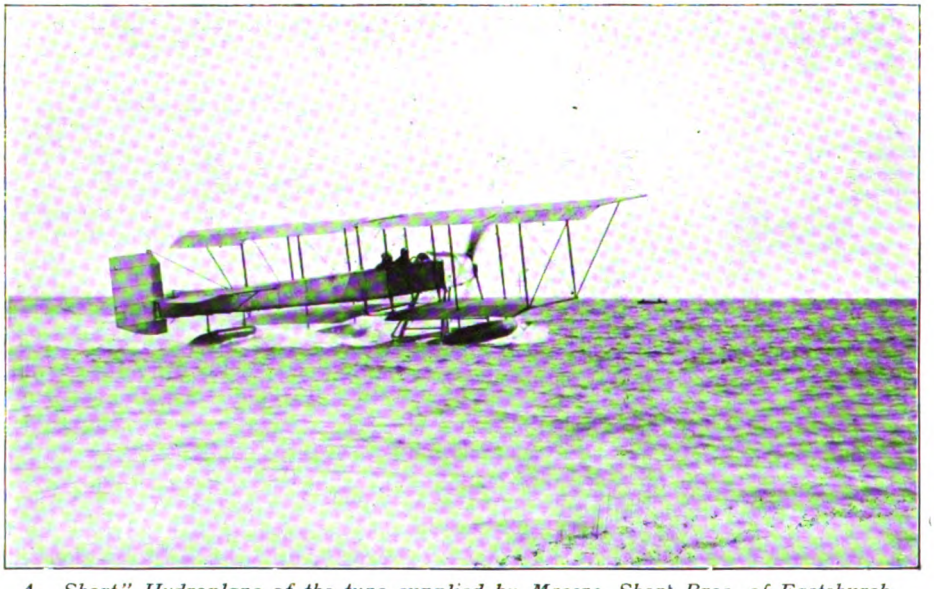
Wireless in Aircraft

FITTED with wireless with a range of 60 miles, carrying guns and speedy in flight, several hydro-aeroplanes are in course of delivery to the British Government. Such was the information conveyed to the country by Mr. Churchill in his speech on the Navy Estimates.

"We believe," said Mr. Churchill, "that the various types of hydro-aeroplanes which we have evolved and which are now being delivered, some of which will carry guns and which are fitted with wireless with a range and for working with the patrol flotilla Stations are being rapidly established, and a number will be complete in the course of the present year. The problem of carrying aeroplanes in ships is also receiving attention, and a cruiser has been attached for this purpose. Altogether, compared with other navies, the British aeroplane service has started very well; the preliminary difficulties have been surmounted, and we shall now be able to move steadily forward in several promising directions."



A "Short" Hydroplane of the type supplied by Messrs. Short Bros., of Eastchurch, to the Admiralty.

of 60 miles, and which can rise and descend in comparatively rough waters, are, to put it very modestly, certainly as good as anything which exists abroad, and from the result of prolonged exercises during the past year at the various naval stations with hydro-aeroplanes and submarines, and in conjunction with the patrol flotilla, we have come to the conclusion that it is necessary that there should be a chain of hydro-aeroplane stations at various points on the British coast-line for naval scouting purposes.

British progress, as Mr. Churchill indicated, has been steady. There are now 40 naval aeroplanes with 60 pilots, as compared with 5 aeroplanes and 4 trained pilots in March last year. By July, when the naval manœuvres take place, there will exist 75 machines and 75 pilots, and by the end of the year it is anticipated that the strength will be a hundred each of men and machines and that the combined strength of the naval and military air fleets will be not far short of 300 machines.

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Free Instruction in Wireless Telegraphy

DETAILS OF PRIZE SCHEME

IN our last issue we announced that a course of instruction in Wireless Telegraphy would be given by means of a series of articles in THE WIRELESS WORLD, at the completion of which examinations would be held and certificates and prizes awarded.

We are now able to give full details with regard to this scheme. The articles (of which the first appears in this issue) have been so framed that anyone having no previous knowledge of electricity will be able, if the articles are followed carefully each month, to understand fully the practical working of a portable wireless telegraph apparatus, in theory and practice, and with a little experience in working will be able to operate such a set successfully.

Those competing for prizes will be divided into three categories :—

1. Members of Territorial units and recognised cadet battalions.
2. Members of Church Lads' Brigade and Boys' Brigade, and recognised cadet corps.
3. Members of the Boy Scouts Association.

On the completion of the series of eleven articles, examinations will be held under proper supervision for those in the above categories who wish to offer themselves.

On the result of this examination proficiency certificates will be given by the Marconi Company to those qualifying.

The following prizes will also be awarded :

(1) **Territorials and Cadet Battalions.**—1st prize, 10 guineas ; 2nd prize, 5 guineas ; 3rd prize, 2 guineas ; and 5 prizes of 1 guinea each.

The following conditions must be observed :—

(*a*) No one may compete who is professionally engaged in wireless telegraphy, or telegraphy, or is a member of Territorial Engineers.

(*b*) No one may compete who has not passed his recruits' course.

A complete set of field station wireless telegraph apparatus will be given to that unit to which the first-prize winner belongs.

(2) **Boys' Brigade, Church Lads' Brigade, and Cadet Corps.**—1st prize, 3 guineas ; 2nd prize, 2 guineas ; 3rd prize, 1 guinea ; and 10 prizes of 10s. 6d. each.

The following conditions must be observed :—

(*a*) Each competitor must be under 18 years of age on the date of the examination.

(*b*) Must have completed at least three months' service.

A complete set of field station wireless telegraph apparatus will be given to the unit containing the first-prize winner.

(3) **Boy Scouts Association.** — 1st prize, 3 guineas ; 2nd prize, 2 guineas ; 3rd prize, 1 guinea ; and 10 prizes of 10s. 6d. each.

The following conditions must be observed :—

(*a*) Each competitor must be a second-class scout and must be in possession of his signalling badge.

(*b*) Each scout must be under 18 years of age on the date of the examination.

A complete set of field station wireless telegraph apparatus will be awarded to the troop to which the first-prize winner belongs, and another set to the troop obtaining the highest percentage number of certificates of proficiency, irrespective of prizes.

Further details as to date and places of examination will be published from time to time in THE WIRELESS WORLD.

A column will be opened for correspondence on the subject of these articles, and any difficulties which arise from time to time will be there dealt with.

Additional prizes will be given should the number competing in any of the three classes warrant such a course being taken.

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Instruction in Wireless Telegraphy

I. ELEMENTARY ELECTRICITY AND MAGNETISM.

IN a course of instruction on wireless telegraphy, dealing, as it does, at every point with the principles of magnetism and electricity, a knowledge of these prinples must either be assumed or be imparted by way of introduction. In this article we will indicate the kind of knowledge of magnetism and electricity needed, and which should be supplemented by a study of standard text-books on the subject.

MAGNETISM.

1. **Permanent Magnets.**—The lodestone is a natural magnet, and if a piece of hard steel is rubbed by it or another magnet it will be found to act in the same way as the natural magnet itself; that is to say, it will point north and south when freely suspended and will attract iron filings. The piece of steel is then "magnetised," and is known as a permanent magnet. One end of the magnet is called the North (N) Pole and the other the South (S) Pole.

If a straight coil is made by wrapping wire round, say, a pencil, and a current of electricity from a battery (the meaning of these words will be explained later) is passed through the coil it will be found that the coil behaves exactly as if it were a magnet.

If we insert a rod of hard steel into the coil and pass the current as before the steel rod will become a permanent magnet. **There are, therefore, two ways of making a permanent magnet.**

2. **Electro-Magnets.**—If, instead of the steel, we insert a rod of soft iron into the coil it also becomes a magnet, but it is only magnetic so long as the current lasts. **This is called an electro-magnet.**

3. **Magnetic Induction.**—As a magnet is made to enter a coil of wire electricity will be induced in the wire, but only so long as the magnet is moved. As the magnet is pulled out of the coil a current flows in the reverse direction. In this experiment the ends of the coil are joined together.

This effect is known as **magnetic induction.**

If we replace the magnet in this experiment by another coil through which we pass a current, thus (as previously explained) turning it into a magnet, we can obtain an "induced current" in the second coil either by moving the one coil in and out of the other or by keeping one permanently inside the other and by making and breaking the current in the first coil. This effect is further increased if the smaller coil surrounds a piece of soft iron. The smaller coil is called the primary coil and the larger the secondary coil.

This experiment illustrates the principle of the transformer or induction coil, which will be dealt with later.

4. **Production of Electricity by Magnetism.**—If a bar magnet is covered by a piece of paper in which a quantity of iron filings has been spread the filings become magnetised by induction and take up definite positions on curved lines on the surface of the paper.

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If the magnet is replaced by a spiral of wire through which a current of electricity is passed a similar result will be obtained.

The space over which this effect is felt is called the **field of magnetic force** or the **magnetic field,** and the lines in which the filings tend to arrange themselves are called **lines of force.** We thus see that a magnetic field is made up of a number of lines of magnetic force, these lines being more concentrated at the poles of the magnet or coil.

If we move a coil in a magnetic field a current of electricity flows in the coil, but only so long as movement is taking place, or, if we keep the coil stationary and move the N. or S. poles of a magnet near it, a similar flow takes place. The deduction we can make from this experiment is **that when magnetic lines of force cross or are crossed by a conductor, electricity is induced in the conductor, and a current of electricity will flow if the conductors are joined so as to form a closed circuit.**

ELECTRICITY.

5. **Static Electricity.**—If we take a piece of amber (the Greek for which is 'Ελέκτρον), from which the name electricity is derived) and rub it with a piece of silk we find that the amber has acquired the property of attracting very light objects, such as fragments of paper, cork, cotton-wool, or pith balls.

Other substances have the same property ; for example, resin, sealing-wax, glass, etc.

These substances when thus rubbed are said to be electrified—that is to say, to have a charge of electricity.

Another peculiar property can also be made apparent, namely, the amber and silk will attract **each other** as well as pieces of paper or a pith ball, but the silk will repel another piece of silk similarly treated, as also will the two pieces of electrified amber. Since amber and silk have no effect on each other unless electrified, these qualities of attraction and repulsion must be due to the electric charges, and it will be found that there are two kinds of charges of electricity of opposite qualities, and that the rubbed amber or glass has one of these charges, while sealing-wax becomes charged with the opposite quality. These are commonly called **positive and negative** charges, and their symbols are plus (+) and minus (—) respectively, and it is found that like charges repel and unlike charges attract each other.

6. If we bring two equally and oppositely charged bodies in contact their charges unite and the bodies are said to be discharged.

It is necessary in making any experiments of this kind that all the apparatus should be perfectly dry ; even a damp atmosphere will render it difficult successfully to carry out such experiments.

7. If an electrified glass rod is passed gently through the hand we find that the rod will no longer attract the fragments of paper or cork. This shows that the electric charge on the rod has been conducted away by the hand and from this we get the term " conductor " for any substance capable of conducting a charge of electricity from one place to another.

8. **Conductors and Insulators.** — All metals are conductors, those most commonly in use being copper, brass, aluminium, iron, etc. To a much lesser extent, the human body and water (except the purest distilled water) are conductors.

The substances which will not conduct electricity are called insulators, and for this purpose the chief materials used in electrical apparatus are glass, porcelain, ebonite, silk, rubber, oils, dry wood, string, and cotton.

9. **Static Induction.—When a body positively charged is brought near another body which is not charged a negative charge is produced in the latter. This effect is called static induction.** Thus, if we touch a piece of paper with an electrified rod and then take another rod which has not been rubbed and hold it to the paper we find that the paper is attracted. This shows that

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the paper must have been electrified by contact with the first rod, and consequently induced an opposite charge in and was attracted by the second rod.

10. **Condensers.**—Static induction is the principle underlying the construction of "condensers." A simple type of condenser consists of a glass plate covered with tinfoil on each side, leaving a margin of glass uncovered at the edges.

This condenser must be supported so that the tinfoil does not touch any other object.

If one side is touched with a glass rod which has been rubbed with a piece of silk as described above, it will be found that this side has been charged positively, and that the other side has been charged negatively by static induction.

If the glass and the surrounding atmosphere are dry these charges can be retained for a considerable time.

The object of the tinfoil is simply to distribute the charge over the whole surface.

Now if we take two pieces of wire and join them respectively to the "coats" of tinfoil and touch them together, the charges on each side will unite, and the condenser is said to be discharged. If a sufficiently large charge has been put into the condenser it will not be necessary actually to connect the two coatings, for when the opposite ends of the connecting wires are brought near enough sparks will pass between the ends and the condenser will be found to be discharged, just as if the wires had actually touched.

The object of leaving a margin of glass round the tinfoil is to ensure a large insulating surface between the coatings of the condenser.

This condenser is called Franklin's pane. Another familiar form of condenser is known as the Leyden jar, which is fully described in the text-books.

11. **Production of Electricity by Chemical Action.**—Electricity can be produced in an entirely different manner to the ways described in paragraphs 4 and 5.

If we take a plate of zinc and another of copper and immerse them in a jar containing dilute sulphuric acid, and we join the two plates by means of a wire, a current of electricity will flow from the copper plate to the zinc plate through the wire. This can be shown by making the current thus produced pass through a coil of wire, which, as already explained, will then act as a magnet, and will therefore deflect the needle of a pocket compass if brought near it.

Such an apparatus for producing electricity is called a voltaic cell. Other substances and other liquids can be used for the purpose. Thus, instead of copper and zinc in sulphuric acid, we can use graphite and zinc in a solution of bichromate of potash (or sal ammoniac), and other combinations can be used for special purposes. These are called primary cells, and a number of such cells joined together is called a primary battery.

12. **Storage of Electricity.**—A simple form of storage cell consists of two plates of lead immersed in dilute sulphuric acid and connected to the copper and zinc plates of a primary cell. The electricity passes into the storage cell, and the lead plate connected to the positive or copper plate of the voltaic cell will be coated with a brown deposit. If the wires are removed the storage cell will retain the electricity in it, and a current will flow when its two plates are connected by a wire. This second cell is called a storage cell, secondary cell, or accumulator.

13. **Potential or Voltage.**—We have been considering a current of electricity flowing in a conductor. This expression is illustrated by the following analogy: Two vessels are joined together by a pipe from the bottom of each, in which a tap is fitted. If we fill one full of water and open the tap the water will flow through the pipe until the water stands at the same level in both vessels. This flow is due to the difference of level in the first instance, which causes a pressure against the tap.

With electricity a similar thing occurs.

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When two different parts of a conductor have a difference of electric pressure a current will flow from that part which has the greater pressure to the other part, until the pressure is equal throughout the conductor. This pressure is called " potential " or " voltage."

14. **Current.**—From the foregoing we get the following definitions :—

(1) A current of electricity flows whenever there is a difference of potential in a circuit.

(2) A current of electricity always flows from a higher to a lower potential.

From this we can say that in the experiment described in paragraph 11 the zinc plate is at a lower potential than the copper plate because the current flows from the copper plate to the zinc plate in the external circuit (although in the cell itself the current is generated on the zinc plate and flows through the sulphuric acid to the copper plate). Hence in voltaic cells and accumulators the plate or plates of lower potential are called negative plates, and those of higher potential positive plates. Thus the current may be considered to leave the cell which produces it at the positive pole and re-enter it at the negative pole.

15. **Resistance.**—In paragraph 8 we have explained the meaning of conductors and insulators or non-conductors. Although no substance is either a perfect conductor, or a perfect insulator, but all possess both qualities in a varying degree, yet the property chiefly possessed by conductors is known as " conductivity," and that by insulators as " resistance." Even the best conductors, however, offer a certain amount of resistance to the flow of electricity, but very much less than that of non-conductors, and conversely even the best insulators have a certain amount of conductivity.

Resistance is the property which a body possesses of opposing the flow of electricity through it. This can be compared with the resistance which friction offers to the flow of water through a pipe. A small pipe will offer more resistance than a large pipe, a long pipe will offer more resistance than a short pipe, and a pipe with a rough interior surface will offer more resistance than a pipe with a smooth surface. Similarly with electricity, the resistance of a conductor is increased as :

(1) The diameter is decreased ;

(2) The length is increased ;

(3) A less suitable material is used.

16. **Electrical Units.**—These three important factors of electricity—namely, the current, the pressure or voltage, and the resistance—are measured by the following units :

The unit of current, or rate of flow, is the **ampère,** corresponding in the water analogy with gallons per second.

The unit of pressure is the **volt,** corresponding with the difference of water level.

The unit of resistance is the **ohm**, corresponding with the friction in the pipe.

These units are the three simple units used in all electrical calculations, and they bear a certain relation to each other, known as Ohm's law.

The statement of this law is as follows .—

The current flowing through a circuit is directly proportional to the potential and inversely proportional to the resistance between the ends of the circuit. This law may be stated in other words thus :—

$$\text{Current} = \frac{\text{Voltage.}}{\text{Resistance.}}$$

$$\text{Voltage} = \text{Current} \times \text{Resistance.}$$

$$\text{Resistance} = \frac{\text{Voltage.}}{\text{Current.}}$$

That is to say, the more pressure we apply the greater the current, and the more resistance there is the less the current.

There are, however, two other units which we must take into consideration—one is the unit of capacity or **Farad,** and the other is the unit of induction or **Henry.**

17. **Capacity.**—The quality of " capacity " can be explained by the following illustration :—

A football bladder will normally hold a

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definite quantity of water; if, however, the water is forced into the bladder under pressure it will hold a greater quantity than before owing to the elasticity of the bladder itself.

The difference between the quantity of water it will hold normally and the quantity it will hold under a given pressure is the equivalent of the electrical capacity of a condenser. If the walls of the bladder are thinner or are made of a more elastic material, although the amount it will hold normally will be the same, the amount it will hold under the same pressure as before will be greater. So with a condenser the capacity will be increased as the thickness of the glass plate is reduced, or if a more electrically elastic material is substituted for the glass.

18. **Inductance.**—All stationary bodies show a tendency to oppose being put in motion. This is called "inertia." Similarly all bodies when in motion show a tendency to oppose being stopped. This is known as "momentum." It is wel lknown that it takes a considerable time for a train to get up full speed. This is due to inertia. Also a train travelling at full speed takes a considerable time to be brought to a standstill. This is due to momentum. In the same way there is a tendency in a circuit to oppose a current commencing to flow through it and to oppose its stopping. This quality is called **inductance. Inductance opposes any change in the flow of electricity in a circuit,** just as inertia or momentum opposes any change in the motion of a train.

Inductance is really due to the magnetic field produced by the current in the circuit, and, as explained in paragraphs 3 and 4, the magnetic field can be varied by the form of the circuit, and so we find that inductance is dependent upon the form of the circuits. Thus a straight piece of wire would have very little inductance, but the same wire wound into a coil would have much more. We have seen that such a coil will produce marked magnetic effects, either by itself or still more with an iron core inside it; whereas a straight wire will be found to give only feeble magnetic effect. So we find that the inductance of the circuit has a direct bearing upon the magnetic effect of that circuit, and that the introduction of an iron core into the coil of wire increases its inductance still further in exactly the same way as it increased the magnetic effect.

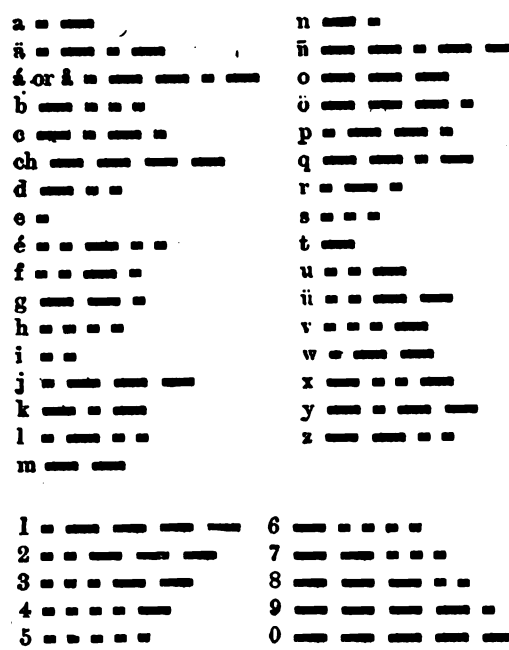
19. **Power.**—The amount of power which an electric current exerts depends on its rate of flow in ampères and on its pressure in volts. The **watt** is the product of one ampère and one volt, and is the unit of power. The kilowatt, or 1,000 watts, is almost exactly one and a third horse-power.

II. Morse Alphabet or Code.

We give below the alphabet and numerals in the Morse code, and in our next issue we will give punctuations and general abbreviations commonly used in Morse communication.

The method by which signals are sent in wireless telegraphy is the same as that used for land and cable telegraphy—namely, the Morse code.

The Morse code as used by all countries



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except America is called the "Continental Morse," and is a dot and dash system throughout, with a maximum of four elements in any letter; an element is either a dot or a dash.

Whatever the speed at which signals are sent, the following rules must be remembered and strictly adhered to:

A dash is equal in length to three dots.

A space between two elements in a letter s equal in length to one dot.

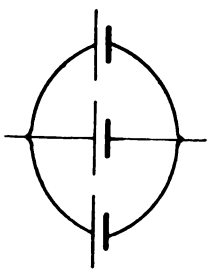
The space between letters in a word is equal in length to a dash.

The space between words in a sentence is equal in length to two dashes.

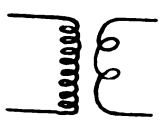
It is of the utmost importance to learners, when practising sending in Morse, that these rules should on no account be disregarded, as it will easilybe understood that the sending and receiving of messages commercially would be difficult between men who had been taught different systems of spacing.

SYMBOLS USED IN DIAGRAMS OF WIRELESS TELEGRAPHY CIRCUITS.

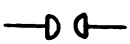
Primary or Secondary Cell.


Battery of 3 Cells in "Parallel."

Battery of 3 Cells in Series.


Transformer or Induction Coil.

Direct Current Dynamos.

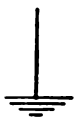

Spark Gap.

Crystal Detector.

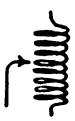
Telephone.

Manipulating Key.

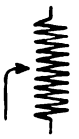
Aerial Wire or Antenna.


Earth Connection.

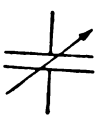
Coil having chiefly the quality of Inductance.


Coil in which the Inductance can be varied.

Rheostat. Coil having Resistance.


Coil in which the Resistance can be varied.

Condenser having the quality of Capacity.


Condenser the Capacity of which can be varied.

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An Amateur's Experiences

By LESLIE H. B. STAVELEY

The Author describes his apparatus and its work, and he concludes with a few useful hints for amateurs

IT is some four or five years ago since I first started "wireless" experiments, my aim being then to receive signals from a friend about a quarter of a mile away. I shall never forget my feelings when I first got "Seaforth." In those days I used an

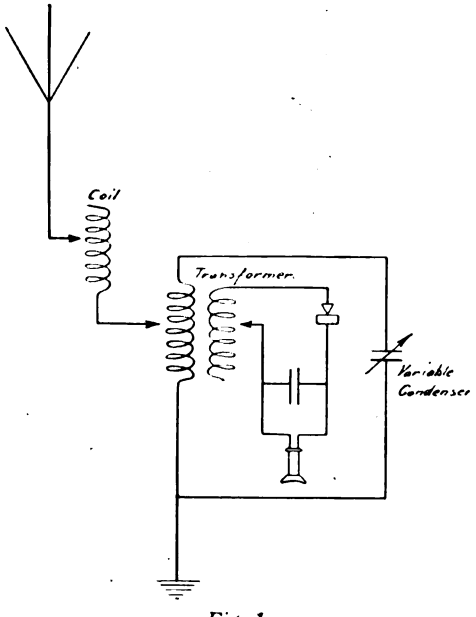

Fig. 1.

aerial 70 ft. long and 20 ft. average height, a silicon detector, and 1,000 ohm 'phone. My next improvement was to instal a double-slide tuning coil. I then used three different kinds of aerials, until about three years ago I first heard Paris. My aerial was then four wires 40 ft. long and an average height of 30 ft. On this aerial I could just hear Poldhu and Cleethorpes.

About twelve or eighteen months ago I put up my last aerial. It was slung between two poles 45 ft. high and 35 ft. apart; the aerial was 60 ft. long, the extra 25 ft. hanging vertically down; the aerial itself consisted of eight wires, No. 16 s.w.g. bare copper wire, arranged in two four-wire "sausages," 4 ft. diameter. The lead in was from the highest end.

Of the poles one was constructed of two 16 ft. sections of 3 in. by 3 in. joist and one 17 ft. section of 2 in. by 2 in. These were bolted together, and the resulting height, allowing for overlapping of sections, was 45 ft. There are stays from each section, which consist of steel clothes-line. The total cost

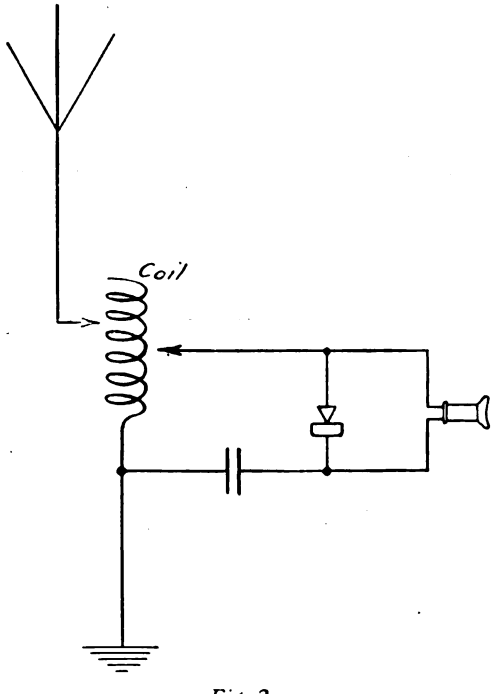

Fig. 2.

of this pole was 9s. The other was a 30 ft. scaffold pole, with a 16 ft. section of 2 in. by 2 in. joist bolted on, and steel stays as on the first-named pole.

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With regard to my instruments. I started, as I have said, with a detector and 1,000 ohm 'phone, connected direct on to the aerial and ground. I then added a double-slide tuning coil, using the connections shown in Fig. 1. For a considerable time I used this with a silicon detector—the one I had used from the beginning. My next improvement was to use a detector consisting of a piece of galena, on which rests a small spring of No. 36 s.w.g. copper wire, which I replace at least once a week, owing to the point oxidising. My next addition was a variable condenser, which I connected across the ends of my tuning coil.

Last summer I made a "Doughnut" oscillation transformer, but could not get very satisfactory results with it, and so made a transformer with a secondary which slides in and out of the primary. With this I get nearly twice as far as I did with my tuning coil.

My latest experiments are testing the efficiency of tellurium and zincite as a detector, and up to the present I have found them about as good as a good silicon detector.

Fig. 3 shows my apparatus assembled as a portable set, which contains a loose couple transformer and a detector (galena) and in the box which constitutes the base is a load coil and a variable condenser. The whole tunes to about 4,000 metres and measures 12 in. by 10 in. by 8 in. The connections are shown in Fig. 2.

The portable set has been designed for use in conjunction with some scouts. The aerial is two wires of No. 19 s.w.g. bare copper wire, slung between two masts at any convenient distance apart, each consisting of six 6 ft. scout poles joined by means of brass ferrule joints and stayed at every joint above the second. This gives very satisfactory results, and I have received up to 1,000 miles by it.

My station is at Liscard, Cheshire, just three miles from Seaforth.

It is, in my opinion, advisable for an amateur to start receiving on a tuning coil, or else, if he starts with a transformer and no experience of adjusting instruments, he may be a month without getting any signals.

My sending consists of a motor-cycle coil, condensers, and sending loose coupler, with the secondary *fixed* outside the primary. My licence allows me 10 watts on a wave-length of 100 metres. If I think the natural wave-length of my aerial is too great I insert a condenser—usually a variable one—in series with the ground. This apparatus, with my portable set gives me a range, under all conditions, of at least five miles. I have been heard up to fifteen miles.

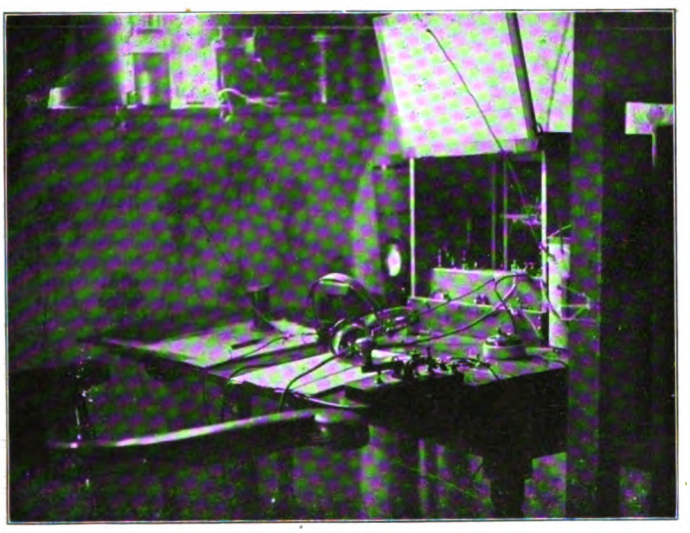

Fig. 3.

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AMATEUR NEWS

THE station shown in the accompanying illustration should have a special interest for our scout readers, inasmuch as it was installed by Scout G. C. Cook, of the 1st Kingston Hill troop, assisted by Scouts R. E. Furniss and R. W. Bowshill, who made the apparatus solely through information obtained from the *Marconigraph*.

Scout G. C. Cook, of the 1st Kingston Hill Troop, operating a station which he himself constructed.

Scout Cook is shown demonstrating his apparatus before a great rally of scouts at Kingston-on-Thames, on the occasion of an inspection by the Chief Scout, Lieut.-Gen. Sir Robert Baden-Powell. We understand that it works exceedingly well, and that messages have been received over long distances.

* * *

The association movement among amateurs interested in wireless telegraphy is growing apace. One of these associations is the Cheshire Radiographic and Scientific Society, which came into existence in February last with the object of promoting the interests of amateur experimenters in wireless telegraphy and kindred subjects by comparison of experiences. Fortnightly meetings of this Society are held at the temporary headquarters of the Hon. Secretary, Mr. R. J. Thompson, Broad Street, Sale. A paper is read and discussed at each meeting. On April 12th Mr. Thompson read a paper and conducted experiments on high frequency phenomena. On April 16th Mr. P. C. Carlett, M.Sc., read a paper on the subject of Condensers. The Society are purchasing standard testing instruments and a lantern, etc.

* * *

The St. Paul's Troop of Boy Scouts, Bournemouth, are evidently determined to

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make a bold bid for some of the prizes which we are offering in connection with the series of instructional articles now appearing in this magazine. A special "wireless class" has been formed, and our articles will be the basis of instruction. The Association are to be congratulated upon the excellent step which they have taken, which can be held out as an example to other associations to follow. The instructors to the class are Mr. C. H. Woodward and Mr. H. C. Binden, and these gentlemen recently delivered an interesting and instructive lecture on the subject, during the course of which they drew particular attention to THE WIRELESS WORLD scheme, and to the inspiring message of approval from the Chief Scout, Sir R. S. S. Baden-Powell.

* * *

Wireless communication was established during the past month between Taplow, Buckinghamshire, and Shirley, near Croydon, by the London Wireless Telegraph Company of the Royal Engineers (Territorials) as part of their Easter training. The detachment at Shirley was with the headquarters of an imaginary invading army, and the men at Taplow were attached to a cavalry brigade operating in Berkshire and Buckinghamshire. Constant messages were exchanged between the Army wireless field stations employed at the two places.

* * *

A meeting for the formation of the Birmingham Amateur Wireless Association was held on April 1st, at Queen's College. There was an attendance of about forty, and the chair was occupied by Mr. W. F. Baxter Bartram. The following officers were elected: President, Captain A. Handley, of the Territorial Wireless Company attached to the Southern Army; Treasurer, Mr. P. Stanley Beaufort; Hon. Secretary, Mr. J. B. Tucker; Committee: Messrs. W. B. Bartram, H. Beresford, A. H. Handford, J. Littley, G. N. Lloyd, F. Perry, L. Ray, and J. J. Shaw. A fixed club-room has not yet been obtained, but negotiations are on foot, and it is hoped that the Society will very shortly be able to settle in rooms where lectures by authorities on the subject will be given, also papers by members. A club aerial will be erected, and various types of instruments installed. The subscription was fixed at 5s. for the current year. Mr. L. Ray kindly offered the Society the use of a room capable of holding forty people, until a club-room was obtained. The address of the Secretary is Brentwood, Alderbrook Road, Solihull, Birmingham.

* * *

The first meeting of the Liverpool Wireless Association was held recently, the chair being taken by Mr. Z. Tomlinson, of Aigburth. The lines upon which the Association was proposed to be worked were fully set forth by Mr. S. Frith (Crosby). It is intended that a room shall be taken in the centre of the city as a clubroom, and that permission be applied for, and a plant erected for the benefit of the members. The annual subscription has been fixed at 5s. It is intended to hold meetings, lectures, debates, exhibitions and also outside excursions, etc., and a cordial invitation is extended to all persons interested in Wireless Telegraphy to apply for membership. Mr. S. Frith, of 6, Cambridge Road, Great Crosby, Liverpool, has been appointed hon. secretary for the new-formed Liverpool and District Amateur Wireless Association, which is the first of the kind in the country. Mr. Frith won the first prize in 1907 in the Harmsworth Electrical Examination, open to the United Kingdom.

Patent Record.

The following patents have been applied for since we went to press with the April number of this magazine:—

No. 7,396. March 28th. Graham & Latham, Ltd., and Bernhard F. Sobatka. Self-inductance or tuning coils.

No. 7,502. March 29th. Ernest S. Heurtley. Wireless telegraphy.

No. 7,610. March 31st. Guglielmo Marconi and Charles S. Franklin. Transmitting apparatus for use in wireless telegraphy and telephony.

No. 7,847. April 3rd. Richard Cartwright. Wireless-controlled vessels.

No. 7,977. April 4th. Graham & Latham, Ltd., L. J. Graham and Bernhard F. Sobatka. Detector for use in wireless telegraphy.

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QUESTIONS AND ANSWERS

We invite our readers to send us questions on technical and general problems that arise in the course of their work or in their study. To enable us to reply in the current number such questions should reach us by the 12th of the month.

U. S. E.—*Wire in Tuner.*—Why is the wire in the detector circuit of the multiple tuner thicker than that in the intermediate and aerial circuits?—*Answer.*—Since the detector circuit of the tuner has to have in series with it the primary of the detector, which is of considerable resistance in itself, it is advantageous to keep down the resistance of the coil in the tuner, so as to keep the total resistance of the circuit within suitable limits. But more important than this point is the fact that the use of the thicker wire makes the coil (which has a definite number of turns governed by the fixed amount of inductance required in it) longer axially than if it were wound of the thinner wire, and this increase of axial length produces a more tubular field and enables the spherically-wound coil of the intermediate circuit to be more closely linked with it.

* * *

P. J. R.—*The Static Transformer.*—Instead of using the convertor with transformer, as in the 1½-kw. set, would it not be possible to have an armature with a secondary winding, so doing away with the transformer, taking two tappings off the separate slip-rings, so admitting of 300 and 600 metre waves being used?—*Answer.*—It cannot be said that what you suggest is absolutely impossible, but it would be a backward step. The whole advantage of a static transformer—and it is a very great advantage—lies in the fact that the long fine-wire windings which are necessary in order to produce the high voltage from the low voltage are stationary, and can therefore be thoroughly insulated—by immersion in oil, for instance—and moreover are not subjected to the strain of rapid rotation. Also, since the windings have not to be rotated, they can be made of thicker wire, since the extra weight and bulk do not matter, and thus the ohmic losses can be reduced. If the machine which you suggest had been under your care for some time we think that you would have been very pleased if you invented the static transformer, with its increased cheapness and its freedom from breakdown.

* * *

B. R. L.—*The 'Phone Condenser.*—What is the influence of the 'phone condenser on the oscillatory currents of the receiving circuit when used with the Marconi Magnetic Detector?—*Answer.*—The currents in the secondary circuit of the magnetic detector are not, strictly speaking, oscillating currents. The oscillations of the incoming wave are transformed, by the action of the detector, into pulses of alternating-current, the major portion of which is of the frequency of the discharges producing the wave-trains at the transmitter—*i.e.*, of the frequency of the wave-trains instead of the actual waves. Mixed up with this frequency—which is, of course, quite a low one—there are frequencies which are multiples of this, namely, the harmonics of the transmitter-note. The effect of the telephone-condenser is to bring the telephone-circuit more or less into resonance with some of these harmonic frequencies, and thus to alter the characteristic quality or timbre of the sound produced; or, in certain cases, it may be adjusted to give resonance with the fundamental note itself. In such a case there is said to be "note-tuning." As a general rule, however, the 'phone condenser is used to modify the quality of the signal so as to suit the ear, without actually strengthening the sound.

* * *

E. W. B.—*Tuning.*—I am using a "plain-aerial" transmitter and an inductively-coupled receiver (crystal) with switch-contact tuning. Knowing that the plain-aerial system is considered to give a practically untuned wave-train, I am puzzled to find that I not only get fairly sharp

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tuning on the primary, but also have to short-circuit the greater part of my secondary circuit.—*Answer.*—The plain-aerial wave-train, though comparatively "untuned," nevertheless has a definite wave-length of its own—namely, about four times the actual length of aerial; it is therefore susceptible, to a certain extent, to tuning at the receiver.* But with the peculiar type of receiving jigger which your drawing shows there are so many effects possible which may mask themselves in the disguise of "tuning." For instance, all the time you are varying your circuits with the intention of tuning, you are also varying the coupling between the two circuits; and you must remember that it is possible to weaken signals by too tight a coupling just as by too loose a coupling. You would be in a far better position to find out what is actually happening if you made or bought some form of wave-meter, with which you could investigate the condition of each circuit separately.

* * *

W. M.—*The Crystallite Detector.*—Can you offer any explanation of the following peculiarity of the crystallite detector? The detector consists of contact between zincite and bornite. As is well known, crystallite detectors have a way of losing their sensitiveness for no apparent reason; and to enable the operator to ascertain if the detector is still sensitive at any time when no signalling is going on a buzzer and cell are made use of. These are placed some distance from the receiving circuit so that the sound is not heard except in the telephones when the detector is sensitive. On discovering, through the sudden cessation of signalling, that the detector has gone "off," I very frequently find that on pressing the push, and so starting the buzzer, the detector is again rendered sensitive; also that very strong signals will sometimes have this effect.—*Answer.*—We think that when a zincite-bornite detector is adjusted for maximum sensitivity, much of the effect is produced by a species of coherer-action between the two crystals. A true crystal receiver acts not in virtue of any coherer action, but by the rectifying power of the crystal. If the crystallite-receiver contact happens to cohere permanently, the receiver will lose the additional sensitiveness due to coherer-action; and the effect of buzzer signals, or of strong ordinary signals, would probably be to restore the extra sensitiveness by breaking the coherence either by a tiny spark or by a thermo-electric effect. Both these things might, of course, produce coherence instead of de-coherence; this is probably what happens in those cases when you find that the buzzer signals will not restore the sensitiveness. Bornite is not a very satisfactory substance to work with; it is so friable. Why not try a zincite-tellurium contact?

* * *

G. L.—*Hundred Yards Range.*—(1) How far will a ¼-in. spark-coil send messages? Will it send 100 yards? (2) Which is the better receiver to use with a telephone having a resistance of a few ohms—silicon or galena? (3) What size of aerial is needed to work about 100 yards?—*Answer.*—Our inquirer must be warned against expecting final and definite answers to questions of this nature. In the hands of an expert the mechanism of an electric bell, driven by a 4-volt battery, can be made to give good communication over a mile or so when the receiver is properly designed. On the other hand, that same mechanism might easily fail to communicate from one room to another when in less expert hands or with less perfectly-designed receiving apparatus. An ordinary motor-car ignition coil, in combination with a little aerial not more than 30 feet in height, can maintain communication over five or more miles with a good receiver; but such a coil used in conjunction with a badly-designed receiver, or with imperfect tuning, might often fail to work over a hundred yards. Again, such a transmitter, even if used properly and in conjunction with a good receiver, might have its range enormously decreased if set up in the midst of houses, for the short waves suitable for such a small aerial would be seriously hampered by such obstructions. In such a case it would probably be better to increase the height of the aerials rather than the amount of power used.

A telephone with "a few ohms resistance" does not sound very suitable for wireless reception. To be of much service it should have enough ampère-turns to give about 150 ohms resistance, and even then is only

* See article on "Syntony" in the *Year-Book*, just published.

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really suitable for use with a very low-resistance receiver such as the Marconi Magnetic Detector. If such a telephone has to be used with a crystal receiver, it ought to be helped by the use of a telephone-transformer, which is really a small induction coil reversed so as to form a "step-down" transformer; the crystal circuit being connected to the fine-wire winding and the telephone to the thick-wire primary winding. The fine-wire winding should be shunted by a condenser. If such a telephone transformer is not to be used, in spite of the fact that a high-resistance receiver, such as a crystal, is employed, then the telephone itself should be wound to have a resistance of the order of eight thousand ohms. If, however, the magnetic detector is used—and for steady communication between a pair of stations there is no equal to the magnetic for simplicity and regularity—then the low-resistance 'phones of about 150 ohms are all that is required. If you will neither make nor purchase a "magnetic," we should recommend you to use, as your standard receiver, a carborundum crystal with a properly-designed circuit and telephone or telephone and transformer, keeping the various more eccentric crystals for experimental work, where uniform and reliable results are not so necessary. If you wish to get the best results possible with your very low resistance telephone and one of the two crystals you mention, you had better choose the alternative which has the lower resistance—namely, galena.

* * *

A. E. M.—*Wireless Telephony.*—Will you kindly explain how the timbre of a sound is conveyed by wireless telephony? It is fairly clear how pitch and intensity can be conveyed, but I do not see how the quality of a sound (as of different voices) is communicated.—*Answer.*— The characteristic timbre of a voice depends on the character of the vowel-sounds. Each of these vowel sounds has a fundamental frequency; thus the *u* in the word *rude* corresponds to a frequency of 176, while the *a* in *father* corresponds to one of 1,188 (Helmholtz).

In speaking or singing, the vocal chords produce the note of the voice, and the function of the mouth is so to modify this note as to produce the required vowel-sound. The note has a certain fundamental frequency, accompanied by a whole series of harmonic frequencies (which are simple multiples of the fundamental), and also by a series of other "partials" or "overtones" which are not simple multiples. Amongst all these series of frequencies, a vowel-sound finds one which is very near to its own value. The frequency of a vowel-sound is not absolutely rigid; it is capable of modification within certain limits; so when the mouth is set to produce a certain vowel-sound, it modifies this to agree with one of the partials in the note produced by the vocal chords; this particular partial is therefore strengthened by resonance with the cavity of the mouth, and the note leaves the mouth with this vowel-sound impressed on it. The pitch of the spoken vowel is determined by the fundamental of the vocal-chord note, which forms the bulk of the sound. The timbre or quality of the sound is determined by the relative values of the fundamental and the various partials, and also by the relative phases of these. All these frequencies, of different amplitudes and different phases, combine into a sound-wave of irregular form—a Fourier's series of mixed waves—which on reaching the ear once more resolved into its component waves.

When the transmitter of a telephone—whether wireless or otherwise—is spoken into, the result is that an electrical disturbance is sent out which has exactly the characteristics of this irregular wave; and, if communication is good, the disturbance maintains all these characteristics throughout its journey and, on reaching the receiver, is converted once more into the irregular sound-wave to which it corresponds. Finally, this latter is resolved by the ear into component waves, and the whole entity of the sound—pitch, timbre and vowel-sound—is recognised by the brain. If the communication is not good, the true form of the compound-wave may not be impressed on the electric disturbance; or, if so impressed, it may lose some of its true form either during its journey or at its reconversion at the receiver; in this case, the received sound is imperfect, articulation may be blurred, and the quality of the voice may be lost.

For a comparison between the merits of

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the wireless and the ordinary telephone, in respect to this point, see the first part of Dr. Erskine-Murray's article in the "Year-Book of Wireless Telegraph and Telephony."

* * *

H. E. H. B.—*Arrangement of Apparatus.*—Having purchased the following apparatus, I should be pleased to know how it may be arranged to give the best results. An aerial wire of height 40 feet and length 60 feet is available. The apparatus consists of 2,000 ohm telephones, various crystal detectors, sliding inductance, small fixed condenser, variable condenser with oil dielectric, and an inductively-coupled receiver with variable primary and secondary. Is this latter a desirable instrument, or would the direct-coupled gear be more satisfactory?—*Answer.*—It is practically impossible to give a definite reply without a more quantitative description of the apparatus at your disposal. The inductively-coupled receiver (or rather "jigger") will be the most satisfactory, if it is properly designed. For use with crystal receivers and others of high-resistance, such as the Fleming valve, the secondary winding should be very long compared with the primary, so that it requires only a very small capacity to put it in tune with the various wave-lengths which you wish to receive; probably both your condensers are far too big for this purpose. A suitable jigger-secondary would require a condenser somewhere of the order of a millionth of a microfarad, and this should be variable; though in your case, since the jigger-secondary itself is variable, this is not so essential. You could easily make a suitable condenser, but the question arises as to whether the secondary you have is sufficiently long. It may be taken as a general rule that the more inductance and the less capacity you have in the crystal jigger-secondary circuit the better the results. If you have a wave-meter at your disposal—which everyone who experiments in wireless should have—you will be able to find your way.

Your jigger-primary should be at one end of the secondary, not at the centre, and you should take care that it is the other end of the secondary which is connected to the crystal.

It is not clear whether your jigger has a variable coupling; if it has not, then you must adjust the coupling by varying the number of turns in your variable primary, and re-tuning by your sliding inductance in your aerial circuit.

With some of your crystal detectors you will require a 6-volt battery and a potentiometer, which should have a maximum resistance of about 500 ohms.

With such a short aerial you are not likely to require a tuning-condenser in series with your aerial, more especially since you appear to have a continuously-variable inductance; with the more usual tuning-inductance, variable in steps only, a tuning-condenser is useful for accurate tuning in between the steps.

Your small fixed condenser might do for the shunt-condenser across the telephones, though it would be a matter of luck if it is the optimum value. Possibly your variable-condenser might be better here, if it is large enough.

The circuits as outlined above may be summed up as follows: aerial, tuning-inductance (possibly tuning-condenser), jigger-primary, earth; forming your primary or aerial circuit. Jigger-secondary, with coupling to primary at bottom end; small (preferable variable) condenser across ends of secondary, forming the oscillating secondary circuit which must tune to the received wave. One side of crystal connected to top end of secondary, the other side through the telephones (shunted by a suitable condenser) to the slider of the potentiometer which is across the battery. Then the correct side of the battery (according to the connection of the crystal) to the bottom end (*i.e.*, the end to which the primary has its coupling) of jigger-secondary. If you are using a crystal which does not require an external EMF, the battery and potentiometer will, of course, be cut out.

We repeat once more the advisability of using a wave-meter wherever you can, exciting the various circuits by means of a buzzer, or else excite the wave-meter itself, and use it as a transmitter of variable wave-length.

Do not forget that your crystal circuit is connected in parallel with the capacity across the jigger-secondary, so that this capacity will be affected by that of the circuit.

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The Imperial Wireless Scheme.

Select Committee Inquiry.

THE Select Committee which is inquiring into the Marconi contract resumed its sittings on Tuesday, March 25th. During the course of the inquiry Mr. Harold Smith, Mr. G. Terrell and Mr. A. Gordon Harvey resigned from the Committee. Sir F. Banbury, Mr. J. G. Butcher and Sir Walter Essex were appointed in their stead.

Sir Rufus Isaacs was the first witness called. In response to the chairman's question whether he had any negotiation with the Postmaster-General in connection with the Marconi agreement, he denied that he had ever had any negotiation, direct or indirect, of any sort or kind, with any officials, with any member of the Government, or with anybody connected with the negotiation from beginning to end. He had not taken any part whatsoever in advising on the agreement; it never came before him at all, and he knew nothing until just before the contract was announced. Up to March 7th, the date when the agreement was signed, he never had any dealings in either the English Marconi Company, the Canadian company, or the Spanish company, or any companies of any sort connected either with the Marconi or any wireless enterprise. He was anxious that there should be no sort of suggestion made hereafter that his denial was incomplete, and he wanted to make it quite clear that he had never dealt in options or in syndicates, or had any interest in any option or syndicate or in any share transaction of any sort or kind, either in his own or anybody else's name, or in that of any company.

The first he heard of the American company or any transaction with the American company was on the return of Mr. Godfrey Isaacs from America. On April 9th his brother told him that he had made himself responsible for taking over a very large number of shares in the American Marconi Company, and asked witness if he and his brother Harry would take any of the shares, not, however, to relieve Mr. Godfrey Isaacs, who offered them as a good investment. He made particular inquiry, and carefully assured himself that the American company had nothing to do with the English company, and was not interested in its profits and operations. He made up his mind not to take any shares in the company.

On April 17th witness met Mr. Harry Isaacs, who insisted that the shares were going to rise, and that they formed an excellent investment. He bought from him 10,000 shares at 2. That was six weeks after the announcement had been published in the Press of the acceptance of the tender of the English company by the Government. On April 9th, if he had accepted his brother's offer, he could have bought them at 1 $\frac{1}{16}$ "I was dealing in my own name," added witness.

On the next day, the 18th, the shares rose as high as 3. On that day the American company authorised the issue of new capital.

"One of the questions I put to my brother when he was pointing out the advantages of investing in these shares was whether the public would get all the same information as had been given to me as to the arrangements made in America. He told me that they certainly would, and that the board would issue a circular. A circular was issued, and the public knew as much as I knew. On the 19th of AprilImy asked broker what was the price of American shares. He was very anxious that I should sell out. I advised him to sell, and he sold for me altogether about 5,000 shares. All these transactions were

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made in my name, and the accounts rendered in my own name, as I have done through my broker for years."

Sir Rufus Isaacs then described how he authorised the sale of the shares on June 20th. "My proportion of the sale was 3,570 shares, averaging £3 6s. 6d. each," he said.

Applying the profit made on 3,570 shares sold to reducing the price paid for 6,430 shares, the result is that the 6,430 shares stand me at a cost of £1 5s. 6d. per share. That is the balance of the whole transaction.

The Chairman: When you were making your speech in the House in October last did the thought occur to you that you could get rid of some of these rumours if you had mentioned your investment in the American Marconis? Because, being Marconis, you can easily understand that one company might be confused with another?

Sir Rufus Isaacs: It did not occur to me, and it does not occur to me now. I will assume that the person who circulated these rumours had information. There were entries in books in my name, and contract notes and accounts; I assume, therefore, that somebody had information. What I want to know, and am entitled to know, is what person, with that information before him, wrote the lies, which were built up on some such foundation? Who is that person? —that is what I want to know.

The Chairman: You thought that your investments in American Marconis did not form a proper topic for remarks?

Sir Rufus Isaacs: I thought it was a proper thing to tell the committee about. What I felt I should do in the speech was to deal with four specific charges which were made. I did not want in any way to confuse any question which was being raised with regard to other matters with these charges—two of them of a very grave character. I wanted the House of Commons and the public to know that there was absolutely no foundation of any sort for any of those statements. I am sure that if anyone had said in October, when I made that speech, that it would be some six months before I should be called before the Committee he would have been laughed at and ridiculed. But at the time that this took place I certainly thought that it would be a very short time before we should be examined. I hope you will not think that I am in any way criticising. I do not intend for a moment to do that, and I do not think there would be any justification. I have stated quite clearly that there is no truth in the rumours. May I add this? At this time, last October, no one had ever suggested that any transaction in any other company —either Spanish or Canadian or American— would in any way savour of corruption, or was the subject matter of criticism of Ministers. The whole of the suggestion from beginning to end was limited to speculation before the acceptance of the tender of March 7th was announced in the public Press on March 8th. That was the statement to which I directed myself.

Mr. Lloyd George was next examined. He explained his position with reference to the negotiations, and the circumstances in which he acquired the shares from Sir Rufus Isaacs. He said: "Perhaps I had better state here that I have never held any interest of any sort or kind either before or after April 17th in the contracting company. Up to April 17th I had not acquired any interest of any sort or kind in any wireless enterprise in this or any other country, and I wish this denial to be of the most public character. I never trafficked or dealt in any shares of the British Marconi Company at any time, either before or after April 17th, neither directly nor indirectly, neither myself nor through anybody else, and beyond what you, sir, have stated to the Committee to-day quite accurately, I never bought or sold or held any interest in any shares in any other wireless concern." If there was any suggestion of corruption, he continued, he would like to have it made perfectly clear while he was in the chair. What were the conditions at the moment the investment was made? The terms of the contract had been announced six weeks before that date in the public Press. It is true that a formal contract had to be entered into, but the real terms of the contract had been announced before. The public knew all about it, and its effect must have been fully understood.

"The British Navy had equipped Marconi apparatus under a contract entered into, not by the present Government, but by the Unionist Government, on most, if not all, the British cruisers. The British Mercantile Marine was equipped with the Marconi apparatus, and I think many foreign countries. It was in this country a large and

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important industry employing thousands of British hands. That was all that I knew about Marconi wireless at that time. All this atmosphere of suspicion which has been created—I am not entering into that now—has all come into existence since then. So much for the question of the character of the investment itself. There was nothing in Marconi wireless that would not have made it a reputable, respectable, and good investment for any person in this country."

Mr. Herbert Samuel, the Postmaster-General, was next called. He gave a complete denial of the rumours that he was financially interested in any of the Marconi companies, or any telephone or telegraph companies in any part of the world.

Mr. Faber asked Mr. Samuel, in view of the fact that he had never held any shares in any Marconi Company, why he did not say that on October 11th in the House of Commons? Why did he restrict himself to dealing with the English Marconi Company?

"Because it was only the English Marconi Company that was in question. I regarded it and still regard it as a question of charges made only in relation to the company which was contracting with the Government," said Mr. Samuel.

He closed his evidence with the following statement:

"If at some later date it is found that grave injury has been done to the Imperial interests by this delay in constructing wireless stations, my duty is to make it clear that I have left undone nothing I could do to obviate that. That is why I protested. The stations might have been half-built by now."

Evidence was then given by brokers, and on Monday, April 10th, Mr. Godfrey Isaacs, managing director of the British Marconi Company, went into the witness chair.

The Chairman said that he was asked to attend that day to give only such evidence as bore upon any dealings in the shares of the British or any other Marconi company by the Attorney-General, the Postmaster-General, the Chancellor of the Exchequer, or by any member of the Government or Government official. He wished to ask, first, what occurred between him and his brothers, Sir Rufus and Mr. Harry Isaacs, at lunch on the day he returned from America?

The witness said that he would like to tell the Committee what did take place in America so that they might better understand what his position was when he returned. Mr. Marconi and he decided to go to America upon hearing that the Judge of the Supreme Court had fixed March 25th for the hearing of the action against the United Wireless Telegraph Company provided that they would give an undertaking to be there. When they arrived in New York he received visits from an attorney representing a committee of shareholders in the United Wireless Company, who had between them subscribed a certain sum of money with the object of taking the affairs of their company out of bankruptcy, reforming the company, and fighting the action pending.

As the result of discussions an arrangement appeared likely, and he realised that there would be an opportunity of taking over the whole of the tangible assets of the United Wireless Company. These were considerable and important. They really covered practically the whole of the wireless business of America. They had practically 500 installations on board ships and 72 telegraph stations all round the coast of America. He naturally appreciated the fact that to take over those assets would require a substantial sum of money, and he also realised that there was a possibility of very big business in America provided his company had money. The American sent a telegram to no matter what part of the world with as little hesitation as we would send a halfpenny postcard. But to create a long-distance telegraph service to all parts of the world without the means of collecting and distributing messages in America would be like playing *Hamlet* without the Prince of Denmark. He determined that there were two courses open—either to arrange with a company like the Western Union Telegraph and Cable Company, or that we ourselves—

A Member: You say "we ourselves"——

The witness said that when dealing with America he spoke as a director of the American company. The other alternative was to compete with the Western Union by constructing wireless stations throughout America and doing their own inland telegraph service. He preferred arrangement to competition. He called a meeting of his American directors and put before them the whole

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of his scheme—first, for taking over the tangible assets of the United Wireless Company, and secondly, for the construction of high-power stations to communicate with the different parts of the world, and, perhaps, failing an arrangement with the Western Union, for the construction of small stations to create an internal telegraph service. He informed the directors that in order to carry out that scheme they would want a very large increase of capital.

He would like to clear up one or two points in doubt about their capital. At that time, dealing in round figures, it was $1,600,000 issued. He told his American directors he would require them to sanction an increase to $10,000,000—$1,400,000 to carry out the contemplated arrangements with the United Wireless Company and $7,000,000 of liquid capital for work he had proposed. The American directors looked upon his scheme as a little bold, but they thought they would like to see it carried through. They assured him, however, that in their opinion there would be no possibility of raising a single dollar of that capital in America. They reminded him that the face value of every share had been reduced from $100 to $25, and that the company had never been able to pay a dividend. Further, the United Wireless had an issued capital of $20,000,000 in $10 shares which had been sold at from $30 to $40. It was not likely, in the directors' opinion, that anybody in America would put another dollar into wireless telegraphy for some time at all events, and they would not agree to any increase of capital unless Mr. Marconi and he undertook to see that the whole was subscribed.

Mr. Marconi personally hesitated very much about giving any such undertaking; £1,400,000 was a very large amount to be responsible for. Mr. Marconi and he conferred in private, and he told Mr. Marconi that in his opinion he would have no difficulty in placing £1,400,000. Mr. Marconi had great confidence in his opinion, but nevertheless did not like taking a responsibility of that amount for the English company, and asked him whether he personally would take 500,000, leaving the company's responsibility 900,000. He said that if he would he would take the other responsibility. He (the witness) agreed, saying he was perfectly confident he could place them quite easily. At that time, again dealing in round figures, the English company held 35,000 shares in the American company. There were, therefore, 29,000 shares in the hands of other persons, making a total of 64,000 shares of $25 each. Each one of those, under a scheme which he had submitted to the American company, would be entitled by conversion to five shares of five dollars each, and each of those five-dollar shares would be entitled to subscribe for five additional shares of five dollars. Therefore, every original shareholder would be the owner of 30 shares provided he paid £25 for 25 new shares. At least there was that right, but his directors were confident that the shareholders would in all probability never even get to hear of the increase of capital, and that, whether they did or not, they would not take it up.

But after the American directors had agreed to the increase of the capital to $10,000,000, after he had successfully carried through the agreements with the shareholders' reorganisation committee of the United Wireless, and after many interviews with the Western Union Cable Company, in which he made them understand that either he was going to compete with them by putting up stations—that they had decided to increase their capital for that purpose—or have a reasonable working arrangement, join them, in fact, as a telegraph organisation, they eventually came to the conclusion that it would be wise to enter into an arrangement, and after long negotiation they came to terms.

The agreement was entered into. It was signed at about half-past 8 o'clock on the night of April 1st, 1912, and he sailed for London on the *Mauretania* at 2 o'clock in the morning on April 2nd. Having entered into his arrangements with the board of the American company and with Mr. Marconi, he then set to work to place his 500,000 shares, leaving the company with the responsibility of the 900,000. If the shareholders did not take them up, he intended making an issue in London to their English shareholders of a further 500,000 to 600,000 of the shares at par. If the American shareholders took up all their shares, his company were still responsible for £875,000.

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But they could not have afforded to take up 875,000 shares in the American company and hold them. Therefore, had they been called upon to take up the whole of the shares, having placed 500,000, there would remain 900,000. Of those they would not keep more than 300,000 at the outside. He was not sure they would have continued to keep those. They would have received five shares for every one they originally held by means of conversion, which would have given 175,000, and they would, perhaps, have increased their holding by 100,000 or 200,000, but he did not think they would have kept more than that. They would therefore have had at least 500,000 or 600,000 shares to place with their own shareholders here.

The witness further stated that while he was still in America he called in Mr. Heybourn and gave him the general outlines of his programme with regard to placing 500,000 of the shares on the English market. His desire was that the shares should be placed at a small premium, and that they should remain so until the business of the company had developed. Therefore, in arranging to place with Mr. Heybourn 250,000 shares in all, at par, which was in England 1 1-16, or in American money $5, he made it a condition that they should be supplied principally to dealers in wireless shares on the English market at a price not exceeding 1¼, which he thought was the price at which the shares might fairly be introduced on the English market. He also placed 150,000 of the shares upon the same terms and at the same price in America with bankers and others.

On Monday, April 8th, he arrived in London with about 100,000 shares unplaced. He invited his two brothers, Sir Rufus Isaacs and Mr. Harry Isaacs, to lunch with him on the following day. He told them what had happened in America. He gave them his opinion of the prospects of the company, and said that in his belief the shares would be a very good and sound investment, that he had 100,000 still to place, that it did not matter to him who took up those shares, and that it was open to them to have any number they liked. His brother Rufus did not care to take any of the shares, and as he had an appointment he left early. His brother Harry, who remained and talked over the matter with him, took a different view of the shares from Rufus, and eventually said he would like to have 50,000. That left him with 50,000 of the shares unplaced. By the following evening, April 10th, he had placed the whole of the balance of the shares. His seven directors took 2,500 each. Mr. Marconi was away in America, and he telegraphed to him and Mr. Marconi replied that he would take 10,000 shares. He himself took the same number as had been taken by each of the other directors — 2,500. He took those shares as an investment, exactly in the same way as he had advised others to take them as an investment. He had never bought or sold a share, and was not interested in the least in the market price of the shares, except to deplore very much that the market should have run away, as it was damaging to his company and created extremely difficult circumstances for himself.

On April 17th or 18th Mr. Heybourn came to him and said that the demand for the shares, principally from America, was so great that the price was already long past 1¼, that therefore it would be absurd of him to place them at 1¼, and he asked his consent to increase the price from 1¼ to 1½. He did not like the suggestion, not because he did not think it was perfectly reasonable in the circumstances, but because he had not placed his own 100,000 shares at a profit, and had no desire to make any profit on them. Eventually he agreed with Mr. Heybourn that he should increase the price of the shares to 1½ provided that he paid 1¼ for them, instead of 1 1-16, because there was no reason why Mr. Heybourn should reap the benefit of circumstances over which he had no control and could not have foreseen. Accordingly it was agreed that Mr. Heybourn should have the 250,000 shares at 1¼ and that the contracts should be sent straight to the company, so that the additional profit of £60,000 or so should go to the company. In his opinion he was perfectly entitled to have taken that profit for himself had he chosen so to do. But he preferred that all the profit should go to the company. He did not make any profit out of his company in any way whatever, other than the percentage which was paid him on the

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profits in addition to the salary he got for his services.

On April 18th Mr. Heybourn telephoned to him that there was a great demand for the shares on the market, and he bid 2⅛ for 50,000 more shares, and they were sold to him at that price. Later on in the afternoon Mr. Heybourn again telephoned that the demand for the shares was far greater than it had been in the morning, and asked for an additional 50,000 shares at 2 1/16. All these shares were sold to Mr. Heybourn on behalf of the company. He had nothing whatever to do with the market. He did not control it.

The Chairman: You told us what occurred at the luncheon between you and your two brothers. Had you anything to do with the sale of shares to Sir Rufus Isaacs, which took place afterwards?—I had nothing to do with it. I did not know of it until about the month of October.

You know, of course, of the rumours that were circulated throughout the summer? Have you any knowledge of any transactions with the British Marconi Company or the American Marconi Company on the part of any of the Ministers of the Crown?—No; I have no knowledge at all. I was constantly hearing of the rumours. The first I heard of them was in the month of April. Directly I returned from America I was informed that there was a very strong attack to be made on the Marconi contract with the Government. It was talked about very freely. I was also told there was a very strong syndicate which was promoting or had been endeavouring to promote the Poulsen Company, and that they were strongly supported by influential persons, among whom were members of Parliament, who would assist them in preventing the Marconi contract being carried through. I took very little notice of these rumours; I scarcely believed them at the time, but they were being constantly repeated to me. I was sent a document which I think has considerable importance, and which I will hand to the Committee. It is a prospectus of a Poulsen radio-telegraph and telephone system which is marked "Private and confidential" and dated March 5th, 1912, two days prior to the acceptance of the tender of the Marconi Company by the Postmaster-General. There are only two names on the prospectus. One of them is the expert engineer who reports on the Poulsen system, and that engineer is A. A. Campbell Swinton, who was warmly recommended by Sir Henry Norman as one of those expert engineers who was well qualified to advise the Committee as to the best wireless system for the Government to adopt. The other name on the document is that of the printer. I endeavoured to find out on whose behalf the prospectus had been printed and by whose instructions and to whom Mr. Campbell Swinton had reported. The only reply I was able to get was that the strictest injunctions had been given that no information was to be supplied by either of these people to anybody, and that all the papers connected with it were to be destroyed. Therefore, so far as I was concerned, the door was closed; but by means of the two names on the prospectus I think the Committee will be able to obtain a great deal more information than they have yet had which will throw light upon two matters—first, the attack upon the Marconi Company; and, secondly, the rumours and charges made against Ministers. I heard in July that those who were connected with this syndicate were arranging an attack upon Ministers in order to make it doubly sure that the contract should not go through Parliament.

I have never repeated any names because I have never had the authority of anybody to use names. I have never repeated any of the rumours because I could not substantiate them. But I have now received a letter which I think will help the Committee. It is a report made to me in order that I might have a record of what was said and in order that I might refer to it and give a name. It is written from 70 Ennismore Gardens, and dated April 8th of this year:

DEAR MR. ISAACS,—It might interest you to know of an incident which occurred to me, and which in my opinion has some bearing on the attitude of the great proportion of those people who have been so loud in their denunciation of the Marconi Company's contract with the Post Office. I was present at a dinner party in the West End last May, and was very interested in the conversation of a gentleman who was explaining to those about him the worthlessness of the Marconi system in com-

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parison with that of the Poulsen. After dinner I asked him if he could tell me more of the merits of the two systems, and if he considered the shares of the Marconi Company to be too high. He told me that he was confident that the shares of the Marconi Company would fall to 30s. or £2; that he had several clients who, on his advice, were bears on Marconi shares, and that, although these clients had substantial profits on their transactions, he was advising them not to close, as the shares were bound to fall to the price he had mentioned. He further told me that he and his friends were very confident about the merits of the Poulsen system, which, in his opinion, was far in advance of the Marconi. He told me that there was going to be a great outcry in the House of Commons against the Marconi Company's contract with the Government, and he mentioned the names of two members of Parliament who were to take a prominent part in the discussion. One of the members whose names he mentioned has, in fact, been very much in evidence in the discussions which have subsequently taken place, and the impression left on my mind is that a certain section of people interested in the Poulsen Syndicate have been devoting their attention to preventing the ratification of the Marconi Company's contract with the Government to serve their own ends. The gentleman who gave me this information was a stockbroker. I have listened for nearly a year to the wildest rumours against the Marconi Company and against the contract, and those rumours have almost invariably come from people who were personally interested in the Poulsen syndicate, or from persons whose interest it was to see a fall in Marconi shares. I have written you on this subject because it seemed so apparent that most of this outcry against the Marconi Company's contract originated from those who were trying to run another system.—With kind regards, believe me, ERNEST G. HAWKINGS.

Mr. Butcher: Who is Mr. Hawkings?

Mr. Godfrey Isaacs: He is a member of the Stock Exchange. Mr. Hawkings has said that he is quite prepared to come here and to name the two members of Parliament and the stockbroker, and to give any further information he can on the subject. If the Committee probes this matter through Mr. Hawkings and this prospectus and Mr. Campbell Swinton I believe they will get a good deal of information to lead them to trace the originators of all the rumours as to the attack on the Marconi contract and the slanders and attacks on Ministers.

The Chairman: Did you offer any advantage or favour to any Minister or Government official in connection with the negotiation of the agreement?

I never did; it would be the last thing I should ever dream of doing, and I should be very sorry if it were possible to do anything of that kind in this country.

Witness was in the chair during the greater part of four days, and he was followed by Mr. Harry Isaacs, who said he did not know that his brother, Sir Rufus had sold any shares to Mr. Lloyd George until his brother came before the Committee and made the fact known. He had no knowledge as to how Sir Rufus dealt with his portion of shares. He (witness) had not had any Marconi dealings prior to April 19th, 1912. Sir Rufus sold 2,000 shares on his advice. He had repeatedly heard the rumours about Ministers, but treated them as ridiculous. He could not give any idea as to their origin.

Mr. Ernest Hawkings, in his evidence, declared that in his letter to Mr. Godfrey Isaacs he did not mean the two members of Parliament, to serve their own ends, were trying to prevent a ratification of the contract.

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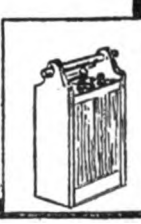

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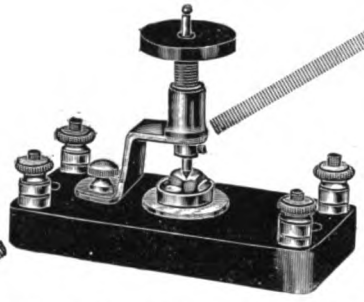

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"THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1913," published by the Marconi Press Agency, Ltd., Marconi House, Strand, London, W.C. 2s. 6d. net.

The publication of this book is a timely reminder of the enormous development of wireless telegraphy. Both in the popular mind and in practice the subject has become so widely established that a thorough digest of information has become an absolute necessity if those who are concerned with wireless telegraphy in one way or another are to keep pace with its rapid progress.

To satisfy the requirements of all interests within a volume of reasonable dimensions was the problem to be faced in the compilation of the year-book. The aim of the publishers has been to produce a volume which shall be at once indispensable to those concerned in wireless telegraphy—whether technically or commercially—and contain information sufficient to make intelligible to the general public the immense variety of matters relating to the subject. Whether his interest be in the purely scientific side or the commercial, whether he desire to know the wireless stations of the world or the rates for a message, or to understand the laws and regulations governing wireless telegraphy all over the world, the inquirer should find in a book of this kind all the facts stated concisely and authoritatively, and we do not think that he will be in any way disappointed.

The year-book opens with a calendar, and is followed by a concise chronological record of progress in wireless telegraphy since 1896. This should prove a very convenient and time-saving reference section. Next follows what many will regard as the most important feature of the work, and one which alone would make it indispensable—namely, the administrative section. This contains the London Convention of 1912, the laws and regulations of the principal countries concerning wireless telegraphy, all carefully prepared in English. Then there is a complete list of land and ship stations of the world, with their call letters, ranges, wave-lengths, the nature of the service hours of opening and changes, set out in a form which makes reference easy. Other features are an article by Mr. Arthur R. Hinks, M.A., Chief Assistant of Cambridge Observatory, on "Wireless Time Signals"; "Distress Signalling," by Mr. G. E. Turnbull, and a mass of useful data. As might be expected, the technical section is particularly strong, and some of the leading experts have contributed. Professor J. A. Fleming, F.R.S., Dr. W. H. Eccles, Capt. H. Riall Sankey, and others no less well known are among the authors of signed articles. Major J. E. Cochrane deals with military wireless telegraphy, and wireless telephony has been dealt with by Dr. J. Erskine-Murray. Almost every branch of the subject has been covered. There is much valuable technical data and a large number of useful formulæ and equations. A very full glossary of technical terms in English, French, German, Italian, and Spanish completes a valuable section.

Brief biographies are given of prominent people in the world of wireless telegraphy, and articles on the part the invention plays in ocean journalism and weather forecasting render the book attractive reading.

Many illustrations distinguish the volume, and one very valuable feature is a new and revised map of wireless stations of the world. Every care has been taken to make this map thoroughly up-to-date and reliable.

The year-book should go on the bookshelf as a standard work of reference on the subject of wireless telegraphy and telephony.

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with many thrilling yarns to spin of the wonderful sights he has seen, or the perils he has gone through, is no longer the hero of his native village—the sure captor of its fairest belle. His time of continued absence is now, in most cases, short. He has, when he returns, nothing thrilling to tell, and his dress no longer differentiates him so markedly from the working landsman. This great transformation is in no small measure due to the progress of steam navigation, the development of which is told by Mr. Talbot in the interesting volume under review. The reader is made familiar with all that there is to be known about the construction and detail of a steamship, but the author has wisely broadened the scope of the subject by dealing with various other influences which materially affect the welfare and safety of the ocean-travelling public. We turn with pleasure to the chapter dealing with wireless telegraphy, in which the author has compressed within about a dozen pages a description of this wonderful invention, which has been one of the most remarkable factors in changing the conditions of ocean travelling. He draws attention to the extraordinary lead which the British Mercantile Marine enjoys in the advantages of wireless telegraphy, due to the commendable enterprise of the Marconi Companies. The other chapters in this book are as well written as that dealing with wireless telegraphy. Although the North Atlantic figures largely in the volume, this is due to the fact that it is the busiest of the seven seas. It is where new developments and revolutionary inventions invariably receive their commercial ocean-going baptism, and any book dealing with the subject of steam navigation in which the North Atlantic did not figure prominently would be lacking in interest. We can heartily recommend Mr. Talbot's book, which is interesting alike for the excellence of the text and the character of the many illustrations.

* * *

"THE ELECTRICAL TRADES DIRECTORY AND HANDBOOK, 1913." (London: The Electrician Printing and Publishing Co., Ltd. 15s. net.)

Familiarly known as the "Big Blue Book," the thirty-first issue of this invaluable annual is in every way as complete as its predecessors. Included in the contents are complete notes of the year's progress in electric traction, electric power, the application of electric driving to industrial works, also developments in submarine and land telegraphy, as well as a record of radio-telegraphy progress of 1912. In addition, the salient features of telephone progress in the United Kingdom in 1912 (including the purchase of the National Telephone Co.'s system by the Post Office), the development of the steam turbine and the internal combustion engine, the progress made in arc and metal filament lamp improvements, etc., are set out, and a summary of parliamentary work in the past session so far as legislation has affected the electrical industry. A record of the proceedings of the Marconi Agreement Inquiry up to the adjournment is also given. The law of electric lighting, electric power, electric traction, telegraphs and telephones is fully dealt with, and a full digest, specially prepared for the "Directory and Handbook" by Mr. A. C. Curtis-Hayward, A.I.E.E., solicitor, is given. There are in all over 2,200 pages in the Big Blue Book, every line having undergone careful and thorough revision up to the moment of publication. For over thirty years this valuable and exhaustive work has occupied the first place as a reliable book of reference for a great and growing industry, international in character; and the 1913 edition, now published, shows no slackening of effort to keep up the high repute of the work.

The wireless telegraph station at Port Stanley, Falkland Islands, has been opened to public service. European business to and from Port Stanley will be handled through the station located on the Cerro at Montevideo, Uruguay, which is 1,243 miles distant.

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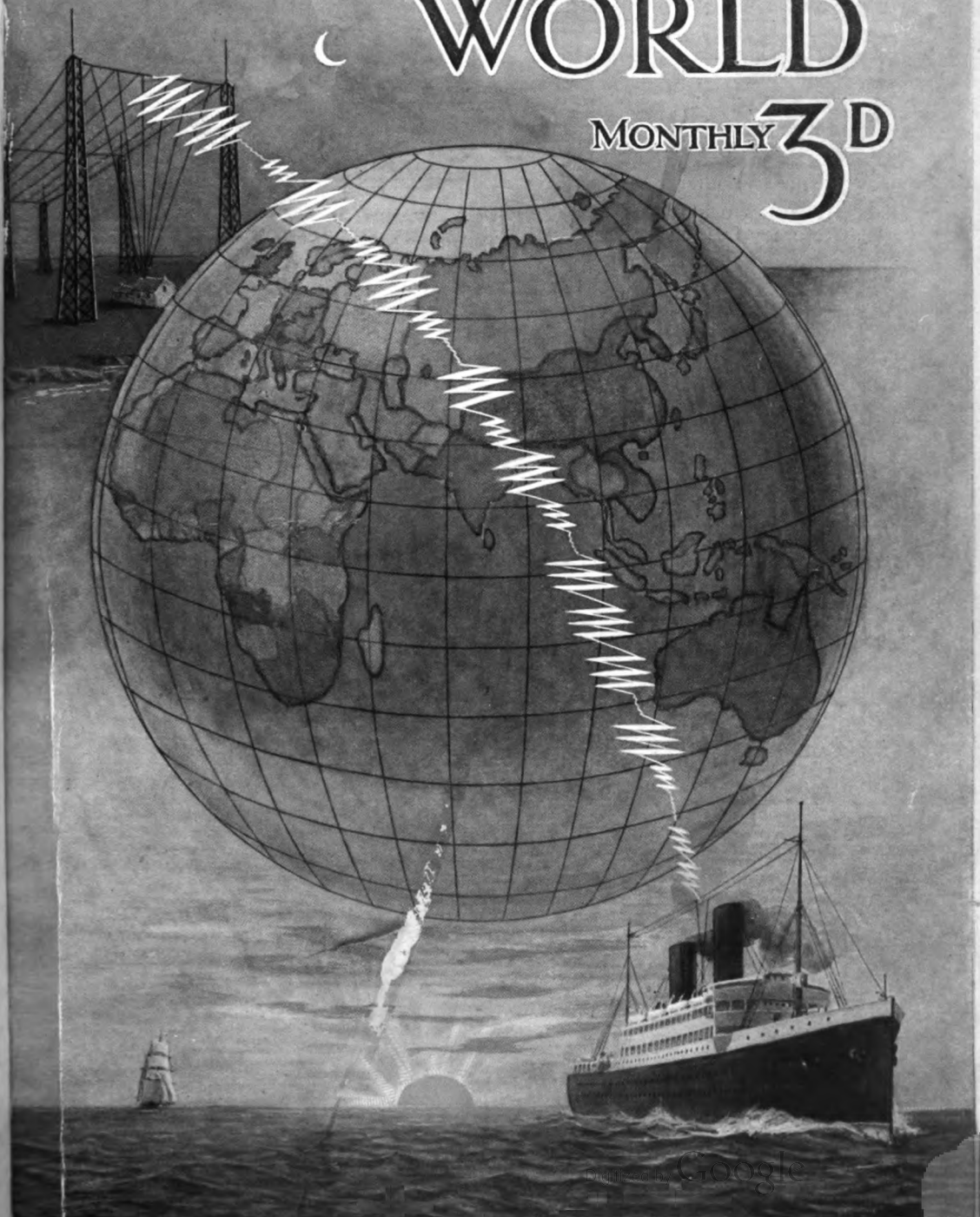
WIRELESS WORLD

MONTHLY 3D



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The Postmaster-General on the Imperial Scheme

THE speech in which the Postmaster-General presented his annual statement in the House of Commons on April 24th was packed with interesting matter. Its outstanding feature was the statement on the telephone service, but it also contained references to the scheme for an Imperial chain of wireless telegraph stations. Mr. Samuel said he had hoped to make much progress before now with the establishment of an alternative system of Empire communications by means of Imperial wireless stations owned by the British Government, by the Dominion Government, and by the Indian Government, but, owing to circumstances with which all were too familiar, this most desirable undertaking had been postponed. Nearly two years had passed since the sub-committee of the Committee of the Imperial defence reported that the project was urgent from the point of view of the strategical defence of the Empire. On January 14th the Select Committee of the House of Commons, investigating this subject, presented an interim report in which they came to the conclusion that the matter was one of urgency, and they asked that an advisory committee of experts should be appointed to report as to the best system to be adopted. The report of the advisory committee, which was not available at the time the Postmaster-General made his speech in the House of Commons, has now been published, and is dealt with fully elsewhere in this number. On January 29th, as Mr. Samuel informed the House, the Commissioners left this country to secure sites in Egypt and East Africa, but he pointed out that the Government could not yet definitely purchase sites for wireless stations, because they held that the contractor who built the stations should take the risk of any failure in their working, and if this very desirable condition was to be maintained it would obviously be necessary to obtain the contractor's approval for the site selected.

Touching upon another point in this speech, it is interesting to note that the wireless stations on the coast show a satisfactory increase in business. The traffic has grown by 15 per cent. last year, and has doubled during the last four years. New coast stations are being erected, and these should be of considerable service to the mercantile marine.

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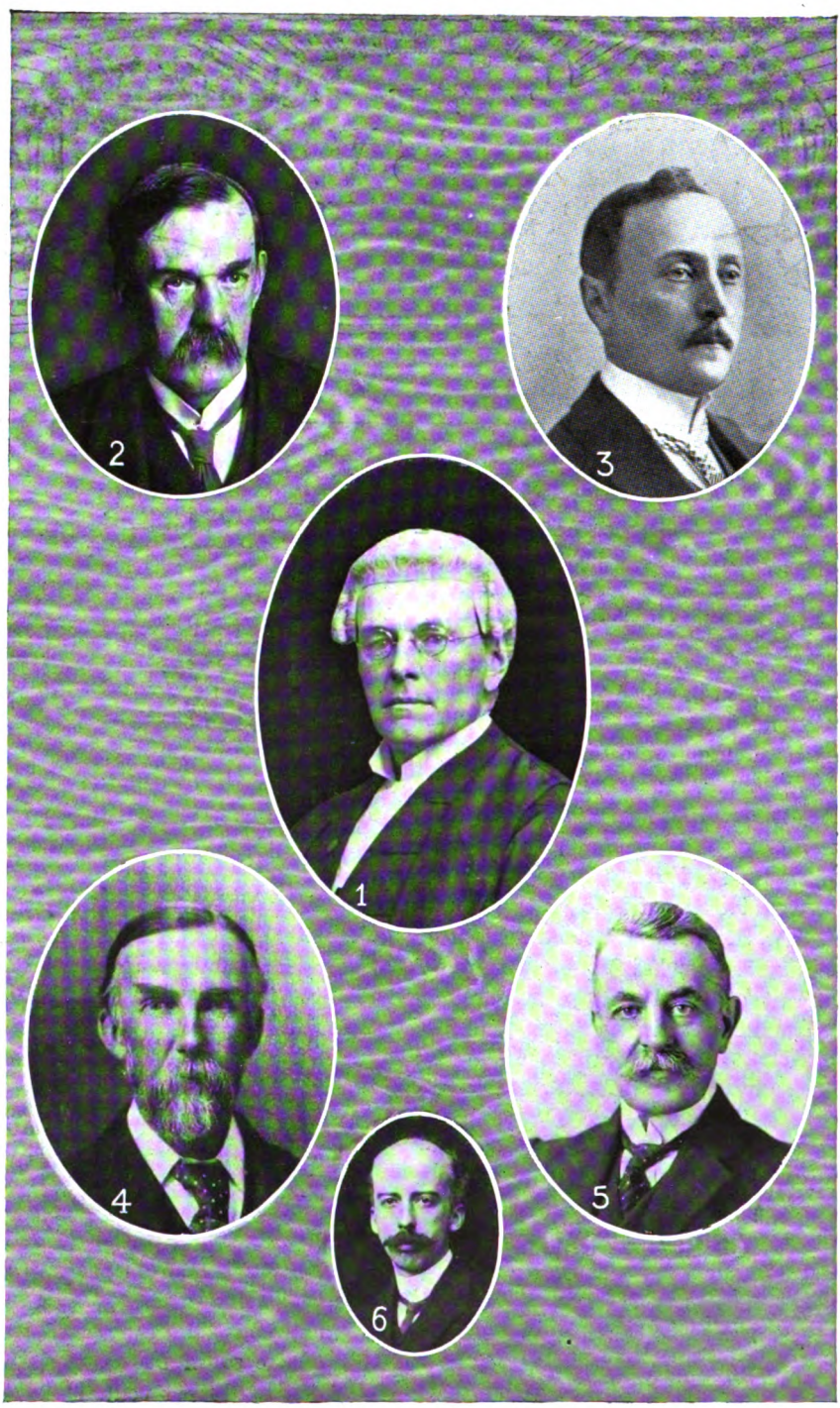

1. Lord Parker of Waddington. *2. Dr. R. T. Glazebrook.* *3. Mr. W. Duddell*
4. Sir Alexander W. B. Kennedy. *5. Mr. J. Swinburne.* *6. Mr. E. H. Rayner*

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All Editorial communications to be addressed to "The Editor, 'The Wireless World,' Marconi House, Strand, London, W.C."

The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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The Members of Scientific Advisory Committee

ON the opposite page appear the portraits of members of the Scientific Advisory Committee, which has just issued its report.

BARON PARKER OF WADDINGTON, the Chairman of the Committee, is perhaps better known as Mr. Justice Parker. For many years he was an eminent judge in the High Court, where he dealt mainly with Patents cases. The famous "Four Sevens" patent action was heard before him, and his judgment in favour of Mr. Marconi and the Marconi Co. was a masterpiece of clear reasoning and lucid statement. He was appointed a Lord of Appeal this year, only seven years after his elevation to the Bench.

DR. GLAZEBROOK started professional life under brilliant auspices. After study at Liverpool College he entered Trinity College, Cambridge, at the age of 18. Three years later he was elected foundation scholar, and the following year took his degree as Fifth Wrangler. Immediately afterwards he commenced the study of Physics at Cavendish Laboratory, under Clerk Maxwell. In 1880 he was appointed demonstrator of Physics by Lord Rayleigh, and ten years later became director of the Laboratory. This position he held until 1898, when he became Principal of University College, Liverpool. In 1882 he was elected Fellow of the Royal Society, and served on the Council from 1892 to 1894. He is Director of the National Physical Laboratory.

MR. DUDDELL served three years' engineering apprenticeship, and was afterwards engaged in research work at the Central Technical College, London. In 1896 he obtained the Whitworth Exhibition, and in the following year a Whitworth Scholarship. His work in connection with oscillographs has made him deservedly famous. He received a gold medal for Oscillographs at the Paris Exhibition in 1900, and at St. Louis in 1904. The Duddell arc, which is well known in connection with wireless telegraphy, was discovered by him. He is now President of the Institution of Electrical Engineers.

SIR ALEXANDER KENNEDY is one of the foremost engineers of the day. His apprenticeship to engineering lasted 4½ years, but he made such good use of his time that when he was only 25 he was already established as a consulting engineer in Edinburgh. In 1874, two years later, he was appointed Professor of Mechanical and Civil Engineering at University College, London, and when, in 1889, he was compelled to relinquish the position owing to the pressure of professional work, he received the honorary title of Emeritus Professor of Engineering from the Council of University College. He has published several books on mechanics and kindred subjects. In 1887 he was elected Fellow of the Royal Society, and received the honorary degree of Doctor of Laws of the University of Glasgow in 1894. He was appointed by Lord Goschen member of the Naval Boilers Committee and President of the Admiralty Machinery and Designs Committee. For these services he was knighted in 1905.

MR. JAMES SWINBURNE is well known as an inventor. He served his apprenticeship in engineering when he was quite young, and was soon distinguished for his attainments. In 1881, when he was only 23, he was returned as first in all England at the Examination of the City and Guilds in Gas Manufacture. Later he went to America, but returned to England to patent a glow lamp known by his name. From that time onwards his inventive faculty has never deserted him, so that a long list of successes stand to his credit. He was President of the Institution of Electrical Engineers from 1912–1913.

MR. E. H. RAYNER, the Secretary to the Committee, is an electrician of repute. He was educated at Cambridge, and served a very thorough apprenticeship with several engineering firms. He now carries on expert testing and research work at the National Physical Laboratory.

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EPISODES OF THE MONTH

PORTABLE WIRELESS TELEGRAPH STATIONS IN THE BALKAN WAR. TELEGRAPHS IN THE NORTH OF SCOTLAND. WIRELESS TELEGRAPHY AND RAILWAYS. AERIAL TRAFFIC IN FRANCE. THE SHARE MARKET.

LAST month we published in THE WIRELESS WORLD a report of the siege of Adrianople, and the part that wireless played in that remarkable episode of the Balkan War. Fuller details have since come to hand, and these are of sufficiently interesting a nature to prove once again that fact is often stranger than fiction. Adrianople was only supplied with a 1½-kw. cart station, which happened to be shut up in the beleaguered town, and this fortunate circumstance alone enabled her to keep in touch with the Government at Constantinople, which would otherwise have been entirely ignorant as to the state of affairs in the besieged city. At no time did the station fail, and during the time that the city was invested over 450,000 words were transmitted to headquarters without a hitch. This, too, in spite of the difficulties the Allies attempted to create by placing one of their stations to the westward of Adrianople, and another to the eastward, so that they might come as nearly as possible in a direct line between the Adrianople and the Ok Meidan stations. As soon as the Ok Meidan station started calling up Adrianople, or *vice versâ*, the Allies hammered away at their two stations in a vigorous but vain effort to jam the Turkish signals. But the efforts of the Turks were entirely successful, and the calls were transmitted and received without the slightest inconvenience. It is acknowledged that the excellence of the instruments and the system of the Marconi Company are chiefly responsible for this phenomenal success.

* * *

The decision of the Postmaster-General to substitute wireless telegraphy for the existing overhead land lines in exposed parts of the north of Scotland will meet with general approval. Business in such important centres as Aberdeen, Dundee and Arbroath has frequently been interrupted, and the towns themselves at times isolated by the breakdown of telegraph lines during severe weather. A wireless station is to be established near Aberdeen which will be in touch with the station at Newcastle-on-Tyne, and so put an end to all inconvenience in the future. The local authorities of the areas concerned have agitated vigorously for the laying of underground lines, but the excessive cost of such a scheme has prevented its adoption. The opposition to the Post Office scheme is based upon a complete misapprehension, if not ignorance, of the everyday accomplishments of wireless telegraphy. A representative of the fish trade, who was a member of a recent deputation to the Postmaster-General on the subject, in communicating to the local Press his views upon the Post Office proposals, said his objection to wireless telegraphy was "that it is still an experimental means of transmitting messages as far as overland is concerned." We do not know where he obtained this remarkable information from; it betrays a curious lack of knowledge of current progress. Far from the overland transmission of wireless telegrams being an experimental matter, it is at present carried out on a very large scale, and in the Imperial wireless telegraph scheme which the British Government have proposed, the transmission of messages will be mainly overland. Wireless telegraphy has been thoroughly tested between London and Liverpool, and the business of

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maintaining regular communication between the north of England and the north of Scotland therefore cannot present any difficulty.

* * *

A serious attempt is now being made on the Lackawanna Railroad in the United States with a view of adopting wireless telegraphy as an aid to the operation of trains, and those who have charge of the experiments seem to be very sanguine as to the results. It may be said in favour of the project that the problem is being approached in a scientific manner, and from the advanced state of the art it is fair to presume that the element of chance in the attainment of results will be largely reduced, if not eliminated. The distance to be covered by the wireless in this instance is comparatively short, and if the system proves to be as successful as it is hoped it will be, it will mean a great deal to the railway services. The section of the road to be equipped is one which is frequently visited by storms, and wire communication suffers more or less in consequence. In order to be independent of such conditions, the railway officials find hope for relief in the wireless, and if they succeed in accomplishing what they have instructed the American Marconi Co. to carry out, a great stride will have been made in the development of the science of railway-train movement. The results of these experiments will certainly be awaited with deep interest.

* * *

The Bill for the Regulation of Aerial Traffic in France, which was tabled last month by the Minister of Public Works, holds a certain measure of popularity because it is framed not only to regulate the entry of foreign airships into France, and altogether to prohibit the circulation of aerial vehicles belonging to a foreign state over France, but to safeguard the landowner, and secure for him the privileges of private property and compensation for trespass thereon and damage thereto by descending aircraft. M. Thierry pointed out in the preamble to the Bill that the number of pilots' certificates issued by the French Aero Club had risen from 17 in 1909 to 359 in 1911, and 490 in 1912, and the number of aeroplanes constructed in France increased from 800 in 1910 to 1,350 in 1911, and 1,800 in 1912. To gain some security from the possible damage of such a flock of aircraft, the landowner is well content to forego his ownership to the air above his land. But there are other provisions in the Bill which may raise some misgivings. M. Thierry's figures regarding the increase in certificated airmen and aircraft are enough to justify legislation which will have a moderate controlling interest; but the French regulations resemble somewhat the measures taken in this country for the control of motor traffic—and incidentally the hampering of the motor industry. That every airship, aeroplane, or balloon, should carry a qualified aviator and have a special certificate, the letter and number of which must be marked upon the aircraft in legible characters, is reasonable enough. But such a system of identification, coupled with the provision that machines must, save in case of necessity, descend upon recognised flying grounds, would seem, as things stand at present, to provide sufficient safeguards against any danger of espionage, without prohibiting, as has been done, the carrying of carrier pigeons, photographic and wireless apparatus. The use of wireless apparatus on aeroplanes and like craft has just emerged from the experimental stage. Very few machines, certainly of a private character, carry such apparatus, and it seems feasible that the French Government, by having such machines specially registered, could, without handicapping useful experimental work or unduly oppressing an expanding industry, ensure no disclosure of its secrets to the prying eyes or ready ears of a foreigner.

The Share Market

London, *May 23rd.*

Inactivity of business and the weak tendency in prices have been the chief characteristics of the Share market during the past month. The prices of the various Marconi issues as we go to press are: Ordinary 4; Preference, 3⅜; Canadian, 13s. 9d.; Spanish, ⅞; American, 1.

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CARTOON OF THE MONTH

Wireless Terms Illustrated

III.—Strong Atmospherics

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The Training of Mercantile Marine Officers and Seamen

By FREDK. H. STAFFORD

The Development of Mercantile Marine Training. The Training Centres. The Preliminary Curriculum. Board of Trade Certificates. The Period of Apprenticeship. The Question of "Prospects." Pay of Mercantile Marine Officers. Life on a Training Ship. The Training of "Fo'c'sle Hands." Instruction in Wireless Telegraphy.

THERE are few callings that demand more varied and special qualifications to ensure success than that of the sea, and this applies with as much force to-day as it did in the old days of masts and yards, and before steam had evolved, so to speak, the modern type of merchant service officer; for it is with him that we will first deal.

Although conditions of life afloat are so very different now, and the slow, old-fashioned sailing ship bears but little relation to the steamer with its speed and comfort, yet the same moral and physical attributes are required from the men who command the present-day steamer.

Sailors as a class are reticent, and, indeed, are apt to be considered a different sort of species from landsmen. There is so much that is beyond the understanding of the ordinary intelligence in their profession that they but rarely speak of it, and then generally only to indulge in a little "leg-pulling." Consideration, however, of the multifarious duties they have to perform, and the extent and varied knowledge they must possess, will at once show that the old-fashioned idea of the "fool of the family" being sent to sea does not apply nowadays, if, indeed, it ever did. Primarily the merchant service officer is a man who first learning to control himself must also be capable of controlling a whole ship's company—which in these days of floating palaces will often total 3,000 souls. He must be well educated and polished, tactful and courteous, and must display exceptional disciplinary ability. Further, he must be sober and calm, quick to act in an emergency; in short, to do the right thing at the right moment. These are a few of the moral qualities he must possess, whilst physically he must have a constitution capable of withstanding all climates and powers of endurance, for such qualities as these he, above all men, is called upon most frequently to display.

The great advance made in marine science calls for a scientific mind to deal with its intricacies, so that we have in the merchant service officer of to-day a man with an exceptionally wide range of knowledge comprising such diverse branches as steam, mechanics, the construction and stability of ships, wireless telegraphy, signalling, etc., with the addition of seamanship, navigation and nautical astronomy.

Sufficient has been said to show that to qualify for such a position much preliminary training is necessary. True, there are many officers to-day who have qualified without any training other than that afforded at sea, but these are the exceptions, not the rule.

Shipowners now generally recognise the necessity of employing officers who have received a course of instruction before going to sea, and to a great extent the passenger lines are officered by men drawn from the two nautical training colleges: *Worcester* in the Thames, and *Conway* in the Mersey; or from the sea-going cadet training ships. These two first-named vessels have between them turned out some 6,000 fully qualified cadets during the past 50 years,

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H.M.S. "Worcester."

A Nautical Training College for Mercantile Marine Officers.

many of whom now hold command in the crack passenger lines, whilst others are serving in different capacities as junior officers or mates of tramp steamers.

The great mercantile shipping of this country is enormous, and its growth and magnitude can be best gauged by a few statistics. Taking the latest figures available, the total gross steam tonnage of vessels of over 100 tons is (according to Lloyd's Register) 17,730,940 tons, representing 8,524 British-owned steamers. These figures are instructive and serve to emphasise the necessity of having properly qualified officers to control the immense wealth they represent.

Some account, then, of the various training ships both for officers and seamen may be of interest and serve to enlighten the travelling public as to the qualifications possessed by those employed in this service.

There are five vessels devoted to the training of officers—viz., the Thames Nautical Training College H.M.S. *Worcester*, the School Ship *Conway*, in the Mersey off Rock Ferry (both stationary), the sea-going sailing ships of Messrs. Devitt & Moore—*i.e.*, *Port Jackson* and *Medway*—and the White Star Line's sea-going cadet training ship *Mersey*. As the education in the two first-named ships is very similar, we give details of the *Worcester* in the Port of London as an example.

The first consideration in entering a boy in the *Worcester* is one of physical fitness, with particular regard to a perfectly normal eyesight. This latter is of great importance, as owing to the new and very stringent tests which have recently come into force any failure in after life would mean the abandonment of the profession and the resulting disappointment and loss of time and money.

The best age to enter is about 14 years, which allows of a boy taking full advantage of the curriculum and of obtaining the necessary certificates.

To quote from the prospectus of the College :—

"The special object of the institution is the training of cadets for a seafaring life, under a captain-superintendent and experi-

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enced masters, with competent seamanship instructors. The cadets are exercised in all the duties of a first-class ship; they are taught practical seamanship, navigation and nautical astronomy, in addition to the usual subjects of a sound English education. Their training, in a word, is thorough, and always with the end in view that, after practical experience at sea, they may become efficient masters of their profession. The cadets are exercised in military and physical drill. Boys are accepted between the ages of 11 and 15½ years at annual terms of admission of 65 guineas, including uniform. There is no entrance examination, but a grounding in mathematics is desirable."

All applications for admission must be accompanied by a certificate of health (including test for vision and colour), certificate of birth, and testimonial of character from last school.

On the scholastic side the curriculum consists of :—English, history, geography, Scripture, French, drawing, arithmetic, algebra, geometry, trigonometry, theoretical and practical, Nautical astronomy, magnetism, the "Deviascope," meteorology, charts, nautical surveying; whilst the technical training includes practical seamanship in all branches, such as knotting, splicing, reefing and furling sails, heaving the lead, management of boats, etc., elementary steam, electricity, wireless telegraphy, and naval architecture, physical and other drills, swimming, hygiene, etc.

The introduction of wireless is a new feature in the training of the embryo officer. The *Worcester*, *Conway*, and the sea-going sailing ship *Mersey*, of the White Star Line, are all fitted with wireless. On the *Worcester* the cadets are given a good insight into its working and the method of dispatching and receiving messages. This is a much-appreciated branch of nautical instruction and demonstrates the up-to-date character of the training.

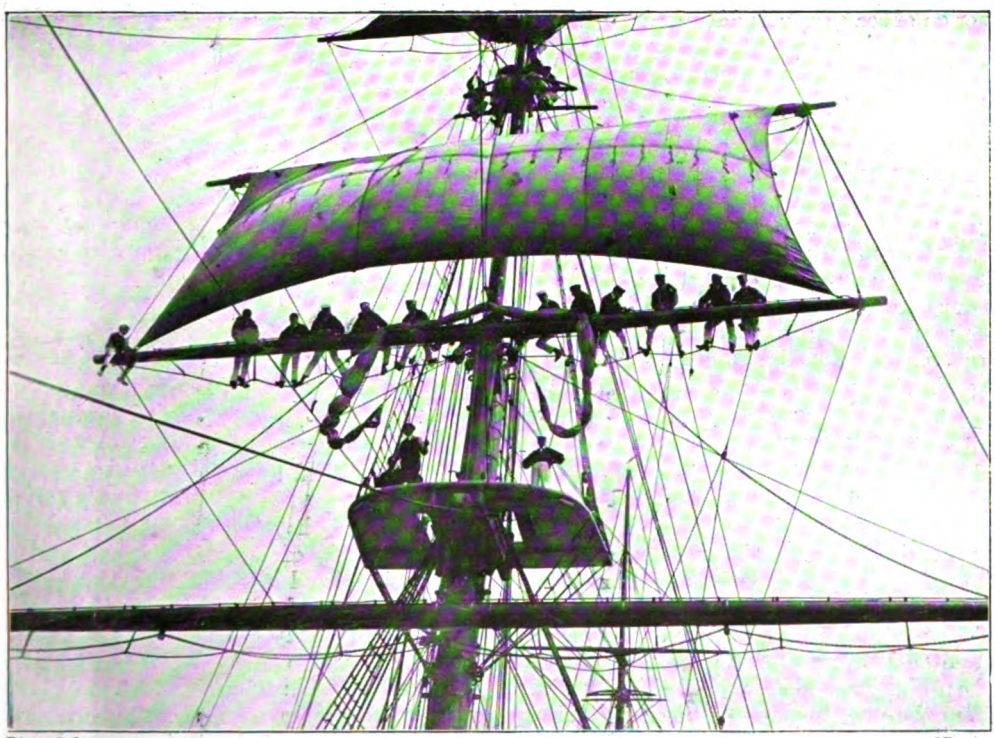

Photo by] "Sail Drill." [Barratt

An important branch of seamanship. Manœuvres being carried out on H.M.S "Worcester".

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After he has spent two years on board and is sufficiently advanced in the various sections, 3rd, 2nd, and 1st nautical, the cadet is examined for his *Worcester* certificate, a document issued under the authority of the Board of Trade, which carries with it a year's sea service, so that instead of having to serve the full regulation period of four years at sea as an apprentice, the holder has only to serve three years.

Shipowners fully appreciate the value of this certificate, and no boy possessing it need have any fear of finding a berth in a good class line.

In addition to the foregoing, the ship is favoured by the Admiralty in the matter of commissions in the Royal Naval Reserve. Every year they grant ten appointments as midshipmen to cadets between the ages of 16 and 18. A first-class *Worcester* certificate is an essential in obtaining one of these appointments. The cadet subsequently undergoes twenty-eight days' training in one of the Home Fleet ships, and on the satisfactory completion of the qualifying period of sea service is advanced to the rank of sub-lieutenant, lieutenant, and, in some cases, to commander.

A special feature of the *Worcester* is the granting of a number of cadetships tenable in the ship by the P. &. O. Co. Realising, as so many other companies have, that something would have to be done to maintain the supply of junior officers, the P. & O. Co. a few years ago decided to make their own arrangements, and accordingly invited a number of applicants to pass an examination, arranged with the authorities, for the entry of some 15 or 20 young men annually, with the object of eventually becoming officers in their service. The P. & O. Co. accordingly advertise periodically that they will pay half the apprenticeship premium (amounting usually to about £50) for boys passing the test. On the expiry of the three years' apprenticeship such cadets pass automatically into the company's service as junior officers to work their way up through the various stages to command. This unique offer has resulted in a large number of boys adopting the profession, and has proved alike successful from the point of view of the boys and the company.

Other notable advantages are appointments in the Bengal (Hooghly) Pilot Service and the Indian Marine. Both these services offer good openings, with the possibility of a pension and a liberal scale of pay.

In the first-named service the scale of pay and allowances (which includes a second-class passage to Calcutta with a grant of £20 towards outfit) is as follows :—

Leadsman	Rs. 100 a month
Second mate leadsman	„ 125 „
First mate leadsman	„ 150 „
First mate leadsman passed as mate pilot	„ 175 „
Mate	„ 400 „
Master	„ 700 „
Branch pilot	„ 1,000 „

and in the Indian Marine :—

Commanders, ranging from Rs. 350 to Rs. 500 per mensem, in addition to staff or command pay.	
Lieutenants on completing eight years' seniority	On Rs. 300 per men.
Lieutenants on completing six years' seniority	„ 250 „
Lieutenants on completing three years' seniority	„ 200 „
Lieutenants under three years' seniority	„ 150 „
Sub-Lieutenants	„ 125 „
Sub-Lieutenants	„ 100 „

It will thus be seen that for the boy fortunate to commence his nautical career under these auspices, there are several excellent appointments open should he tire of the merchant service and seek new fields.

APPRENTICESHIP.

Following the course of preliminary training comes the three years' sea service, requisite before the young man can sit for his Board of Trade examination as second mate—the first rung on the ladder that leads to command; and here some consideration of the particular method of sea training requires to be considered.

In the first place, as everyone knows, the picturesque sailing ship is fast disappearing from the waters, and it is to be anticipated that in a few years more it will have entirely vanished from the British merchant marine.

The more's the pity, for in these vessels the great body of present-day commanders were trained, and it is doubtful whether the facilities afforded by steam training will produce an equally excellent type of officer. At the same time there are many who hold the opinion that in an age in which mechanics play such a large part, the time spent in sailing ships is wasted. Witness the Navy, where masts and yards have long ago been displaced.

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The boy, however, still has an opportunity of getting his first taste of sea life in sailing ships, and many take advantage of it.

Of the firms still owning these vessels, mention may be made of Messrs. Devitt & Moore's two fine vessels, specially designed for carrying apprentices; the Inver Line, owned by Messrs. George Milne & Co., of Aberdeen; the White Star Line, whose fine vessel the *Mersey* is also specially commissioned for sea training; John Stewart & Co., of London; Thomas Law & Co.; Crawford & Rowat, of Glasgow; and several others. All these afford a splendid training at varying premiums.

Until within the past few years few steamship companies carried apprentices, but with the rapid growth of tonnage more officers are required, and so many of the largest companies have taken upon themselves the training of their future officers. Particulars have already been given as to the steps taken by the P. & O. Company, and others have fallen in line. Such are the Royal Mail Steam Packet Company, the British India Steam Navigation Company, the New Zealand Shipping Company, the Bucknall's Steamship Lines, and the Harrison Line of London, George Thompson & Co. of Aberdeen, Walter Runciman & Co. of Newcastle, the Wilson Line of Hull, and others too numerous to mention.

Sufficient has been said to show that there are numberless opportunities for boys to gain experience of sea life, with the added advantage of a good sound nautical education.

[Photo by] [Barratt

Hoisting Boats on H.M.S. "Worcester."

As to the cost of apprenticeship, it is difficult to give any very definite figures. Some companies do not require premiums at all, others demand anything from £10 to £50 or £70, and return all or a large portion in the form of wages. In this respect the ships of Devitt & Moore's and the White Star Line are on a different footing, as these have special schemes which include a certain amount of scholastic as well as nautical training. Particulars, together with a deal of other useful information, will be found in "How to go to Sea in the Merchant Service," published by James Brown & Son, of Glasgow.

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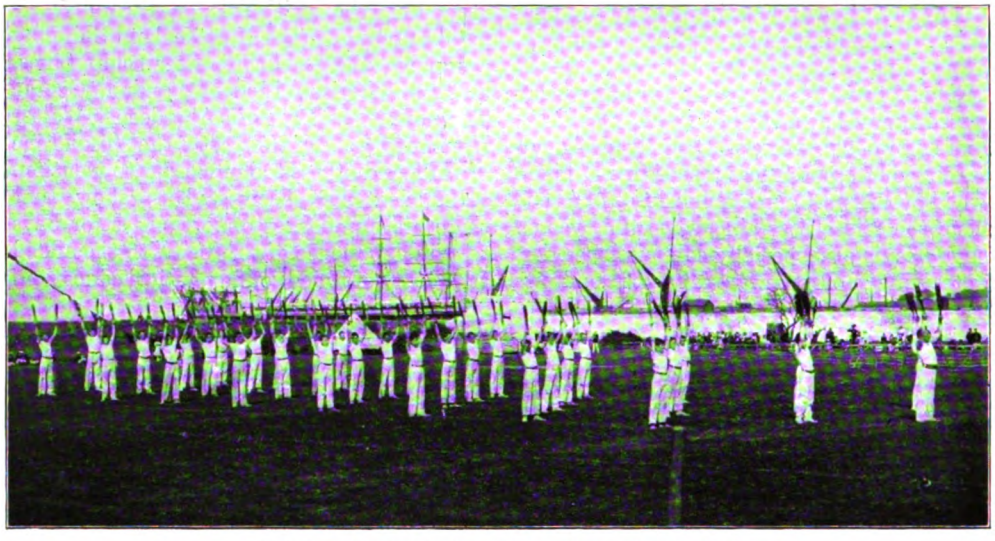

H.M.S. "Worcester" Boys on their Sports Field.
An Indian Club Display.

The question will naturally be asked as to what are the prospects, after spending time and money in equipping a boy for the sea? To this the reply may at once be given that for every youth who has a mind to give himself up to his profession, there is the possibility of obtaining command of a fine ship with a good income.

PAY OF OFFICERS.

The commander of a first-class passenger steamer can earn as much as £800, and in some cases £1,000 per annum, but these figures are only reached after many years' service, and naturally it is not every boy who can hope to arrive at the top of the tree. Still, the pay of the service has recently been increased, and the conditions generally open to these cadets are much better than obtained ten years ago. In good-sized passenger ships the pay of the various grades may be roughly summarised as follows:—Large passenger steamers: Chief officer, £14–£20 per month; second officer, £10–£13; third, £8–£9; fourth, £7–£8 10s.; fifth (where carried), £6. Cargo steamers: Chief officer, £10–£12; second, £8 10s.; third, £7–£8; fourth (where carried), £6 10s. In addition, some of the companies give annual bonuses of from £25–£50, according to rating.

LIFE ON A TRAINING SHIP.

There is very little difference between the mode of life on the ships catering exclusively for officers. Each, of course, has its own little singularities of *régime*, but all are organised on similar lines. But to give an idea of such life we will take a particular example, and there is none better for this purpose than that of the *Worcester*. It is a model training ship, and in the same way as its system of education is typical of this class of training, so life on board, as the writer's personal experience can prove, is typical of all similar institutions.

One of the old "wooden walls" of England, the ship presents an attractive sight as she lies slightly swaying on the waters at her moorings in the Thames off Greenhithe. She looks so spick and span with her white painted ports and spotless decks that it is difficult to believe she was laid down 80 years ago—in September, 1833, to be precise.

Since those days what wonderful changes have taken place in marine propulsion. To imagine the old ship now as a fighting machine with 74 guns is to conjure up an absurdity, yet for 26 years the noisome steam-engine knew her not; one might say she maintained her virgin purity until the year 1859, when she was fitted out as a

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screw steamer, and her original name of the *Royal Sovereign* was changed to that of the *Frederick William*.

She did not, however, long survive as a commissioned ship, for in 1868 she was paid off at Portsmouth, and later handed over to the *Worcester* committee to again undergo transformation. Her boilers and engines were taken out, and she was refitted in the style she now presents, being rigged aloft in modern sailing ship fashion in the main, and in the old style in the fore and mizzen masts. When in commission she had a complement of 418 men besides the captain and officers, whilst now she affords accommodation for some 170 cadets and a staff of 30. The first thing that strikes the visitor on stepping aboard is the cleanliness and orderliness of everything about her. Her stern is surmounted by the poop, where are the private quarters of the captain-superintendent. At the fore end is the topgallant forecastle, where the galley—equipped with the most up-to-date cooking arrangements—and the cabins and workshops of the carpenter and chief cook are situated.

The upper deck is broad and spacious, and in fine weather is a splendid playground for the cadets, offering as it does glimpses of the many interesting craft continually passing up and down the river. Here the usual nautical games, such as "sling the monkey," are indulged in. On the starboard side is a 4-inch breech-loading gun for exercising the Royal Naval Reserve cadets.

The classes are held on the main or school deck, each class being divided into divisions for scholastic work, and sections for seamanship. These latter are again divided into "tops," as main, fore and mizzen. The fore part of the main deck is taken up by the mess room, where all meals are served, being presided over by the cadet captains.

The White Star Line's Sea-going Training Ship "Mersey."

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When meals are piped in true nautical fashion, the mess room becomes alive with dozens of strong healthy-looking youngsters, with animal spirits only equal to their appetites.

The lower or sleeping deck is reached by the ladder, and reveals a serrated row of neatly-slung bunks, which are hooked up in the daytime so as to leave plenty of space. Each cadet is responsible for the cleanliness and tidiness of his particular quarters, and thus early learns habits of discipline which should serve him in good stead when he once gets afloat.

Abaft the mainmast is a hatch that leads to the library and model room, and below this again are the gymnasium and engine room, fitted out with electric dynamos, which serve the double purpose of lighting the ship and affording a means of instruction for the cadets. Such, briefly, is the *Worcester*, and it is safe to say that no healthy boy could fail to enjoy his life amongst such surroundings.

The daily routine is carried out as near as possible to that of a sea-going vessel. The cadets are turned out at 7 a.m., and after breakfast stow hammocks and sweep decks. Then come three hours of schooling, with a short interval for amusement. Afterwards seamanship and drills are taken, and then dinner. The afternoon is again devoted to school work, followed by clearing decks, and then tea. The gymnasium and library occupy the rest of the day, with an interval for supper, and at 8.30 prayers and "lights out."

The boys are allowed ashore on Wednesday and Saturday afternoons, when they repair to the fields where cricket, football, etc., are indulged in. In the summer months much practice is obtained in the swimming bath moored near the ship, and by boat-sailing.

Perhaps the most looked-for event is prize day, when the friends and relations of the cadets, by the invitation of the committee, journey down the river to witness the distribution. On these occasions the ship is always visited by some distinguished person, who addresses the cadets; and many valuable prizes, granted by shipowners and others interested in the shipping industry, are regularly distributed.

Although the greater part of this article is devoted to the training of officers, we will—it would not do to finish without—glance at what is being done towards supplying fo'c'sle hands for the mercantile marine, and in considering the various ships devoted to this branch of the service, it is necessary at once to discriminate and classify.

They may be divided into two types—I., voluntary training ships; II., industrial school ships. A third might be added—*viz.*, the reformatory ships, but they scarcely come within the scope of this article. The first class cater entirely for boys of good character and poor parentage, and the second for boys who have committed some minor offence but have not been convicted. It is only fair to say that this last class make equally good seamen.

To the first type belong the *Arethusa*, *Warspite* and *Indefatigable*, and the shore establishments of the Lancashire Navy League and National Sea Training Homes and the Watts Naval Training School; to the second, the *Clio*, *Wellesley*, *Mount Edgcumbe*, *Southampton*, *Empress*, *Mars* and *Formidable*, the last a shore establishment. From this group of ships a very large proportion of the fo'c'sle hands are drawn, so much so that the remarks in the first part of this article applying to the necessity of preliminary training for officers may also here be made in the case of seamen. A glance at the education afforded in one of these ships, to each of which attaches a history, is typical of the majority. We select the *Indefatigable* at Liverpool. Here the boys are well grounded in the three "R's" under the rules of the Board of Education, and in addition such subjects as the following are taught: algebra, mensuration, mechanics, signalling, navigation, meteorology, rule of the road, advanced geography, seamanship, and wireless telegraphy, consisting of transmitting and receiving messages by the buzzer circuit, a 400-ft. silicon bronze wire (two-fold) being stretched between three masts, two feeders being brought down to the receiving office aft. Messages are read from Cleethorpes, Poldhu, Clifden, Eiffel Tower (Paris), and other stations, at the rate of 17 to 20 words a minute. It will be seen that the *Indefatigable* specialises in this last science, as it is generally recognised that smart boys can be well placed as assistant operators,

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with a surety of advancement at good wages. The period of training varies in the different ships from twelve months to three years, and on the completion of their training the boys are found berths at about £1 per month to start with, all found. After three years' sea experience they become able seamen at about £5 per month. The most intelligent of the lads do not, however, stop here. The education, both technical and scholastic, has enabled many of them to rise to the position of master of a ship, and indeed, in one case at least, to becoming a post-captain in the Royal Navy. The recent decision of the Government to make a grant of £10 per head per annum towards the training of these boys as seamen will enable the training ships to add to their sphere of usefulness, which, it may be mentioned, rely very largely upon contributions from the philanthropically disposed public. They are all in need of support, and, offering as they do a healthy, vigorous life to the youth of the nation, are most deserving.

Teaching Wireless on the "Lancashire."
This is one of the Navy League and Sea Training Homes.

CAPE RACE STATION

The wireless telegraph station at Cape Race, which is operated by the Marconi Wireless Telegraph Company of Canada for the Canadian Government, has been temporarily put out of action through a fire which occurred there on May 5th. Fortunately New York and Boston bound ships are now on the extreme southerly course, on which a number of them pass beyond the range of Cape Race station. The ships now on the southerly track communicate as usual with Sable Island, and by means of re-transmission by ships in the neighbourhood, the telegraphic communications will not adversely suffer. It is hoped that the Cape Race facilities will be restored some long time before the ships change to their northerly track.

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Long Distance Wireless Telegraphy

Report of the Advisory Committee to the Postmaster General

ON January 23rd, 1913, a Committee was appointed by the Postmaster-General (the Right Hon. H. L. Samuel) to consider and report on the merits of the existing systems of long-distance wireless telegraphy, and in particular as to their capacity for continuous communication over the distances required by the Imperial chain. In view of the urgency of the question, the Committee was desired "to report as soon as possible, and in any case within three months from the date of their appointment."

The constitution of the Committee was:

The Right Hon. the Lord Parker of Waddington (Chairman).

W. Duddell, F.R.S.

Dr. R. T. Glazebrook, C.B., F.R.S.

Sir Alexander B. W. Kennedy, F.R.S.

J. Swinburne, F.R.S.

E. H. Rayner (Secretary).

The following is the report of the Committee, which is dated Royal Courts of Justice, April 30, 1913:

Report

To the Right Hon. H. L. Samuel, His Majesty's Postmaster-General.

SIR,—Under the terms of our appointment we are requested to report, within three months, on the merits of the existing systems of long-distance wireless telegraphy, and in particular as to their capacity to fulfil the requirements of the Post Office for the proposed Imperial chain of wireless telegraphic stations. These requirements involve continuous communication between station and station by day and night over land and water and over distances of between 2,000 and 2,500 miles.

2. Immediately after our appointment we took measures to ascertain what systems of wireless telegraphy there were in existence, and by whom such systems were controlled. These systems appear to be the following:—(1) the Marconi, controlled by the Marconi's Wireless Telegraph Company, Ltd.; (2) the Telefunken, controlled in this country by Messrs. Siemens Brothers; (3) the Poulsen, controlled in this country by the Universal Radio Syndicate; (4) the Goldschmidt, controlled by the Anglo-French Wireless Company; and (5) the Galletti, controlled by the Galletti's Wireless and Telephone Company.

3. We also advertised with a view to ascertaining whether there were any new inventions or improvements in apparatus employed in wireless telegraphy, the consideration of which might be useful for the purpose of our inquiry, but such advertisement led to no useful result.

4. It appears, however, that the Admiralty, while in the main making use for communication between his Majesty's ships and shore stations and between ship and ship, of apparatus similar to that employed by the Marconi Company, claim nevertheless to have introduced important improvements. These improvements may be of some materiality; for the Admiralty desire that each station in the proposed chain shall be capable of communicating with His Majesty's ships. It should be considered, therefore,

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whether any system adopted by the Post Office for the purposes of the Imperial chain ought not to be capable of being worked in conjunction with the Admiralty appliances, especially as to the wave lengths to be employed.

5. Having ascertained the various systems into the merits of which we had to inquire, we decided, after consulting the firms by whom such systems were controlled and with their approval, that our meetings should be held in private, and that all evidence given before us on their behalf should be treated as confidential. This was, in our opinion, necessary in order to obtain the fullest information from business rivals.

6. We have heard evidence on 11 days. In Part I. of the First Schedule to this report will be found the names of the several witnesses called on behalf of the firms controlling the several systems of wireless telegraphy to which we have referred. In Part II. of the same schedule will be found the names of the several witnesses who attended to give evidence at our request. We have also personally visited and inspected the several stations and works mentioned in the Second Schedule to this report.

7. For wireless telegraphy two kinds of plant are required; one for sending and the other for receiving. At the sending station there is power generating plant consisting of steam or internal combustion engines and their accessories or electric motors driven off some available power supply circuit. There is a generator of electric power giving the electrical pressure and current necessary for the devices used in the next step. The apparatus used in the next step may be called the high frequency generator and this takes many forms. Finally, there is the aerial to which the high frequency generator supplies energy, the supply being controlled by the operator's key or by automatic sending mechanism. At the receiving station there is also an aerial and some detector apparatus enabling the signals to be heard with a telephone or to be recorded automatically. Automatic recording apparatus is always necessary in the case of high-speed transmission.

8. The term "System of Wireless Telegraphy" is not really apt. Each company or firm engaged in working a wireless station uses apparatus protected by its own patents and has to avoid the use of apparatus and devices protected by the patents belonging to other companies or firms. The main differences in the apparatus and devices at present in use centre in the high-frequency generator; but there are other apparatus or devices protected by patents, such as special aerials, different types of automatic high speed transmitters and of receivers and recorders. Any company or firm which makes use of apparatus or devices which others are precluded from using because of the existence of some patent may claim to have its own system of wireless telegraphy, but the term "system" is misleading, inasmuch as by far the major portion of the buildings and plants could with minor modifications be used equally well with any high-frequency generator or other patented device.

9. The existence of a patent may seriously interfere with the normal development of an industry, for it tends to prevent the general use of the means best adapted for securing the end in view. It may well be that a competent engineer, if asked to erect and equip in the most efficient manner a chain of wireless stations such as the Post Office contemplates, would desire to combine apparatus, the combination of which is difficult if not impossible because of the existence of patent rights. In this connection we desire to lay stress on the fact that the Government is not fettered by considerations arising out of patent rights, but can use any patent on fair terms under section 29 of the Patents and Designs Act, 1907.

10. Subject to the above criticism on the use of the word "system" the existing systems of wireless telegraphy may be

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divided into two classes according to the type of high-frequency generator used. In the first class, the production of high frequency currents depends on spark discharges giving groups of oscillations, and therefore intermittent trains of ether waves In the second class, the generator produces oscillations which for practical purposes may be treated as continuous, and therefore as giving continuous ether waves.

To the first class belong the Marconi and Telefunken systems, and to the second class the Poulsen, the Goldschmidt, and possibly the Galletti systems.

The Poulsen high frequency generator is a modification or development of the singing arc fed by direct current.

The Goldschmidt high-frequency generator is a dynamo, giving an alternating current of a fundamental frequency of the order of 10,000 periods per second. The frequency is increased by the use of suitably tuned oscillation circuits, each successive circuit adding the fundamental frequency of the machine.

The Galletti generator involves a series of spark gaps arranged to operate in a cycle so that the discharge of each causes, and is immediately followed by, the discharge of the next in the series, the sequence of discharges being so rapid that the resulting oscillations may be viewed as practically continuous.

11. Though at present making use of generators depending on spark discharges producing groups of oscillations, both the Marconi Company and the Telefunken Company are developing and experimenting with generators of their own, producing continuous oscillations. The Marconi continuous high-frequency generator consists essentially of a rapidly rotating contact maker in a direct current circuit with special dispositions of other circuits to give continuous oscillations in the aerial. The Telefunken continuous high-frequency generator consists of an alternator constructed to give as high a fundamental frequency as may be convenient in the first instance, the frequency being doubled or quadrupled by a polarised transformer method. In making use hereafter of the term Marconi system or Telefunken system, we do not include either of these generators.

12. In order to test the efficiency of the various systems to which we have referred for the purposes of the Imperial chain, we invited the companies or firms by which these systems are controlled to give us practical demonstrations thereof, if possible on a commercial scale, and if possible over distances of 2,000 miles and upwards. Except in the case of the Marconi system we did not, however, obtain any demonstrations on a commercial scale, or any demonstration over a distance of even 1,000 miles. It is right, however, to state that, according to the information given to us, it was in several cases impossible for the companies concerned to arrange for the demonstration as desired within the short period which we could allow for the purpose.

13. In order that we might test the Marconi plant at Clifden, the Postmaster-General permitted us to avail ourselves of the services of a small staff of skilled operators, who stayed there for a complete week, keeping continuous watch on the actual commercial working between Clifden and Glace Bay, and reporting to us very fully. These reports, for which the Committee acknowledge their indebtedness to Mr. S. E. J. Burrow and his assistants, contain full and valuable evidence as to the commercial working of the plant now in use.

14. We then went to Clifden, and the Marconi Company put the station at our disposal. Through the courtesy of the Canadian Government, we were represented at Glace Bay by Mr. C. P. Edwards, general superintendent of the wireless service of the Canadian Government, who had the assistance of one of his operating staff. Mr. Edwards was provided with a number of sealed messages by our Secretary, and he was instructed to open and superintend the

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transmission of these when and as requested by the Committee at Clifden, and to take charge of similar messages sent from Clifden to Glace Bay, and to send them by post to the Secretary. Mr. Edwards made reports and comments from time to time during our visit, and despatched a detailed account to us later.

15. The Marconi Company use at their Clifden station a high-frequency generator, in which condensers charged from the high tension batteries are discharged by projections which are fixed on a rapidly rotating wheel, and which pass close to metal discs on each side of it. Each discharge produces a group of high-frequency oscillations in a primary circuit, according to the Company's usual practice. We observe that, for the purposes of the Imperial chain, they proposed to charge the condensers from an alternator through a high-tension transformer, as is their practice elsewhere, including the long distance station at Coltano. This method is in our opinion preferable.

16. At Clifden the Marconi Company use their directive aerial; and they have a second separate station for receiving from Glace Bay without being disturbed by the simultaneous sending at Clifden. They demonstrated duplex working while we were at Clifden and Mr. Edwards was at Glace Bay, all interference of the outward waves being eliminated, though the strength of the received signals was somewhat reduced.

17. The Marconi Company is, we are satisfied, working on a commercial scale between Clifden and Glace Bay, a distance of about 2,300 miles, though at present the number of messages transmitted either way is not so great as to require duplex working or high speed transmissions. We were, however, present when messages were transmitted automatically at the rate of 60 words (of five letters) a minute, and we see no reason why this rate should not be considerably increased if it becomes necessary. The communication is practically continuous, though there are, no doubt, periods when the signals become very weak, and even occasional periods when no signals can get through. Periods of this nature are due to natural conditions, and will be incident to the working of any system. During such periods communication can, in our opinion, be insured only by the use of great power in the aerial. We understand that for this reason, and having regard to the increased power required for high speed transmission, the Marconi Company proposed to employ for the Imperial stations practically double the power now used at Clifden. Even so we think there may be periods when communication is impracticable, especially in tropical regions where atmospheric disturbances may be expected to cause more difficulty than over the Atlantic.

18. With regard to the Telefunken system, which, like the Marconi, is largely used, its practicability on a commercial scale for distances of 2,000 miles has not yet been proved. Experiments are now being made between Nauen and Togo, a distance of 4,000 miles, and the results indicate that communication over this distance is already possible at night.

19. With regard to the Poulsen system, we are satisfied that it is practicable for short distances. The Poulsen arc has been tried between San Francisco and Honolulu, a distance of about 2,100 miles, but as to its practicability over this distance we have n. evidence except that which was in the possession of the Post Office long before our appointment. The results obtained do not appear to have been very satisfactory. In our opinion the power used was insufficient. No one tendered any evidence on behalf of the Company which is working between San Francisco and Honolulu, and the firm controlling the system in this country was apparently in ignorance of how it is now working in America. We have recently been informed of important experiments between Arlington and the U.S.S. "Salem"

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and between Arlington and Gibraltar, using both the arc and spark transmission; but full details are not yet before us. We conclude that if the Poulsen system is to be so developed as to be practicable for commercial purposes over distances of 2,000 miles or upwards, the arc will have to be constructed so as to supply the aerial with higher power, or use will have to be made of a more sensitive receiver.

20. Similarly, with regard to the Goldschmidt system, it is no doubt successful over short distances, and the only thing required to make it practicable over long distances is a machine of the necessary power. When the Goldschmidt station near Hannover and the corresponding station on the other side of the Atlantic are complete and in working order, we expect that communication between them will be established by the use, either alone or in conjunction with improved receiving apparatus, of the Goldschmidt machine which we inspected at the station near Hannover, and which was admirable both in design and workmanship

21. Though continuous waves may be somewhat more efficient than intermittent trains of waves, and though the strength of the received signals may probably be increased by the use of improved receiving apparatus, we are of opinion that having regard to the experience of the Marconi Company, and in view of the demand likely to arise for high speed transmission, it would be desirable in the first instance to insist on high powers for the Imperial chain whatever system be adopted. At present, with the exception of the Goldschmidt machine at the station near Hannover, we have seen no continuous high-frequency generator capable of putting into the aerial as much power as is put in by the Marconi Company at Clifden for their Transatlantic service.

22. We may add that both the Poulsen arc and the Goldschmidt machine are admirably adapted for high speed transmission. Though we have not seen transmission by either at a higher speed than in the case of the Poulsen arc 70, and in the case of the Goldschmidt machine 60 words a minute, we have no doubt that these speeds could be increased.

23. We have had no evidence as to the practicability of the Galletti system even over short distances.

24. We report, therefore, that according to our investigation the Marconi system is at present the only system of which it can be said with any certainty that it is capable of fulfilling the requirements of the Imperial chain, but this must not be taken to imply that, in our opinion, the Marconi Company must necessarily be employed as contractors for all the work required for the Imperial chain. Indeed in some respects it might, we think, be better for the Government themselves to undertake the construction and equipment of the necessary stations, acting for that purpose under the best technical and scientific advice which can be obtained, and employing the most suitable contractors for the various portions of the work or plant. On the other hand, it may be said, and is no doubt the fact, that at the present moment the Marconi Company alone has had practical experience of the sort of long distance work required, including experience in putting down stations, in organising the traffic and staff and in coping with the difficulties that arise in a new industry, and the value of such experience and organisation may well outweigh other considerations, if rapid installation and immediate and trustworthy communication be desired.

25. Further, in our opinion, wireless telegraphy is in a condition of rapid development, and this development will in all probability involve the ultimate substitution of high-frequency generators producing continuous oscillations for high-frequency generators dependent upon spark discharges which produce groups of oscillations. Continuous oscillations should allow of more accurate tuning and greater selectivity, and may be better adapted for use in conjunction with improved receiving apparatus. The

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need of high-frequency generators producing continuous oscillations has long been felt by telegraph engineers, and has led to the various devices for the generation of continuous high-frequency oscillations to which we have already referred.

26. The only continuous high-frequency generator we have yet seen tried with success over long distances is the Marconi continuous high-frequency machine to which we have already referred. For the purpose of witnessing transatlantic experiments with this machine we paid a second visit to Clifden, and experiments were made with it in our presence. Using it, Mr. Marconi, on the 26th and 27th of April, 1913, sent from Clifden to Glace Bay messages prepared by us for the purpose, such messages being at our request at once repeated from Glace Bay by means of the Company's ordinary plant and correctly received at Clifden. The power put into the aerial by this machine for the purpose of the experiments was not sufficient for commercial purposes, but there seems no reason why higher power should not be obtained.

27. These experiments, in our opinion, warrant the belief that all or any of the devices for the generation of continuous waves to which we have referred may at no distant date be shown to be capable of successful use for the purpose of long distance wireless telegraphy. Many engineering firms are also engaged in designing high-frequency alternators, and it seems probable that various other devices suitable for long distance wireless telegraphy may shortly be available.

28. Again, there is some evidence that the design of the aerial is in a transition stage. At present there are engineering difficulties in building perfectly satisfactory aerials for the longer waves which appear to be most appropriate to long distance telegraphy. Aerials, especially high aerials, are frequently blown down or damaged by wind.

29. The directive aerial used in the Marconi system has the advantage of not requiring very great height and of giving preference in the desired direction. Its use in connection with the separate receiving station comparatively close to the transmitting aerial makes duplex working practicable. We see no reason why this form of aerial should not be capable of use with any form of high-frequency generator. Moreover, the development of the aerial may facilitate the use of still longer waves for long distance work, and this may profoundly affect the problem of the high-frequency generator, by rendering possible the employment of simple alternators for the production of the frequency required, high though it must still be.

30. Receiving plant may take many forms. Thus the first receiver may be a crystal contact or some discharge valve on the lines of the Fleming valve, and this may work any one of various kinds of relay; and the record may be made by a Morse inker, by photography, by a phonograph, by simple telephone, or otherwise. There is a wide field here for experiment and development.

31. Having regard to these facts it is, in our opinion, undesirable that in constructing and equipping the stations of the Imperial chain the Post Office should be pledged to the continued use of any apparatus now used in any so-called system, or be subject to any penalty by way of continued royalties or otherwise for the disuse of any apparatus which may be installed in the first instance. It is, we consider, imperative that in any contract which may be entered into the Post Office should reserve complete liberty of action in this respect. Further, the stations should be constructed and equipped with a view to the possible and probably rapid development of the art, and we think it would be wise that at any rate two of the stations should be used at once, not only for commercial purposes, but as experimental stations in which the various high-frequency generators hereinbefore re-

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ferred to, and also any suggested improvement in any part of the apparatus, should as far as possible be thoroughly tested. This would involve the employment of a highly trained staff with an engineer of special knowledge and of high standing at their head, but the information thus obtained would be invaluable for the construction and equipment or the improvement in the design of the stations.

32. Even when all the stations are constructed, equipped and in working order, we do not think it would be wise to cease using some of the stations for experimental purposes. We have already referred to the possibility that the existence of patents may fetter the normal development of an industry. A Government monopoly may stop its growth altogether, and is almost sure to do so unless the Government department which works the industry is ready to welcome and test any new invention or improvement, to adopt and use it if the test be satisfactory, and to pay for it on fair terms if it be adopted. For the purpose of testing, examining and, if necessary, further developing any new invention or suggested improvement in wireless telegraphy, a trained staff with an engineer of special knowledge and standing at its head will be necessary. Under the guidance of such a staff and engineer we see no reason why the Post Office wireless stations should not be ultimately equipped with apparatus far more efficient than that now used in any so-called system, more especially as the Post Office will be able to combine, in spite of existing patent rights, apparatus or devices which, because of the existence of such rights, cannot now be combined by anyone else.

33. We desire to add that the provisions of the Agreement, now the subject of inquiry by a Select Committee of the House of Commons, are not, in our opinion, within the terms of our reference; but nothing we have said in this report must be taken as expressing our approval of such provisions.

34. In conclusion, we wish to acknowledge our indebtedness to—

The Government of the United States, for placing the aerial at Arlington at our disposal for experimental work across the Atlantic and for other facilities and courtesies, and to the American Embassy for their kind offices in this matter.

The Government of the Dominion of Canada and the High Commissioner for their kindness in providing a representative of the Committee at Glace Bay.

The French Government, for offering the use of the Eiffel Tower for experimental work.

His Majesty's Foreign Office, for facilitating our journeys abroad.

The Lords of the Admiralty for permitting their officers to give evidence, and for showing us their stations and giving us various information.

The Post Office for the use of their station at Cullercoats; for allowing their officers to give evidence; and for lending us a staff of skilled operators to keep continuous watch at Clifden and to be present and assist us at other stations.

We also wish to acknowledge the hospitality of the Goldschmidt Company, who showed us their stations, and all their plant at Slough and at Neustadt near Hannover; the Marconi Company, who showed us their Clifden station, and allowed us to interfere very considerably with their commercial work; the Poulsen Company, who showed us their Lyngby station working, and their large generators at Copenhagen; and Messrs. Siemens, Bros. & Co., and the Telefunken Company, who showed us their station at Nauen.

We also wish to thank Messrs. Bergmann for allowing us to examine the large Goldschmidt machines during construction; to Messrs. Lorenz and to Messrs. Pedersen for showing us their works.

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We also wish to express our thanks to the various witnesses. Many of them were eminent men whose time is very valuable.

We are also greatly indebted to the National Physical Laboratory for permission to avail ourselves of the services of our most efficient Secretary, Mr. E. H. Rayner, whose assistance has been of real value.

PARKER OF WADDINGTON.
W. DUDDELL.
R. T. GLAZEBROOK.
ALEX. B. W. KENNEDY.
J. SWINBURNE.
E. H. RAYNER, *Secretary*.

NAMES OF WITNESSES HEARD ON BEHALF OF THE COMPANIES OR FIRMS INTERESTED.

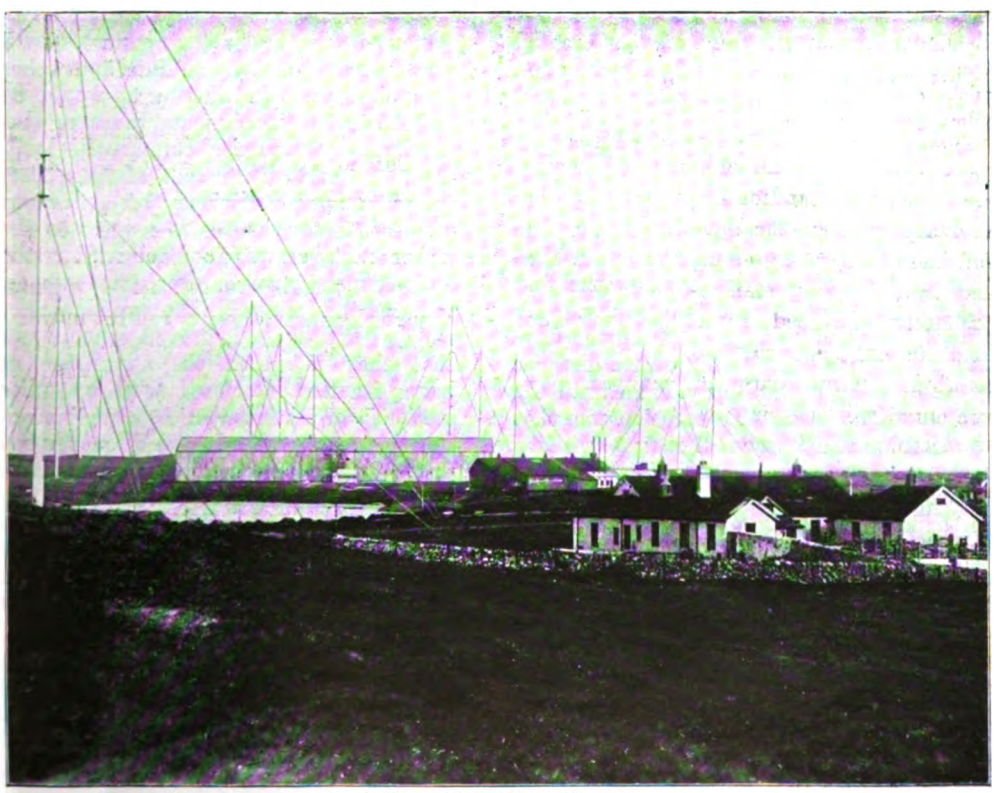
Dr. R. Goldschmidt (Goldschmidt).
Dr. J. Erskine-Murray (Goldschmidt and Poulsen).
Mr. Rappis (Galletti).
Mr. G. Marconi (Marconi).
Mr. Hird (Telefunken).
Professor Pedersen (Poulsen).
Mr. Campbell Swinton (Poulsen).
Professor Silvanus Thompson, F.R.S. (Poulsen).

NAMES OF WITNESSES INVITED BY THE COMMITTEE TO GIVE EVIDENCE.

Vice-Admiral Sir Henry B. Jackson.
Commander W. R. W. Kettlewell, R.N.
Lieutenant D. W. Roe, R.N.
Lieutenant J. A. Slee, R.N.
Commander Loring, R.N.
Mr. H. A. Madge.
Mr. J. E. Taylor.
Sir Oliver Lodge.

STATIONS AND WORKS VISITED.

The Admiralty Station, Whitehall.
The Admiralty High Power Station, Horsea.
H.M.S. "Vernon."
The Goldschmidt Station, Slough.
The Marconi Station, Clifden, Ireland.
Messrs. Bergmann's Works, Berlin.
Messrs. Lorenz's Works, Berlin.
The Telefunken Station, Nauen.
The Poulsen Works, Copenhagen.
The Poulsen Wireless Station, Lyngby.
The Goldschmidt Station, Neustadt, Hannover.
The Post Office Station, Cullercoats.



A View of Clifden Station

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The Imperial Wireless Scheme.

MR. MARCONI'S EVIDENCE BEFORE THE SELECT COMMITTEE.

MR. G. MARCONI gave evidence before the Select Committee of the House of Commons on the Marconi agreement on Wednesday, May 7th, and he presented a long statement which gave in outline the history of wireless telegraphy.

At the commencement of his statement Mr. Marconi pointed out that all the distances referred to by him in his evidence were measured in sea miles, with some exceptions, which he mentioned. In passing, he drew the Committee's attention to the fact that many of the distances between certain points already cited by former witnesses to the Committee must have been given without any attempt at verification, and were wrong in nearly every instance—that was, they were greatly overestimated where they were mentioned in connection with other systems, and underestimated when dealing with the Marconi system. The distances referred to by Mr. Marconi had been measured by him, and his figures confirmed by both a sea captain and an ex-lieutenant of the Royal Navy. He recalled that it was no longer ago than 1896 that he took out in this country the first patent for electric-wave telegraphy. He traced the growth of the art from the days in which it was being tested over a distance of a few miles on Salisbury Plain until the present time. A notable occasion was that in March, 1899, when the first wireless message crossed the English Channel, and another was his discovery, as the result of an experiment, that the curvature of the earth did not interfere with the transmission of his signals. This it was which led him to attempt to send messages across the Atlantic, and he told how, when that feat had been accomplished, *The Times* availed itself of the new method of news transmission.

In a reference to his patents, he spoke of the directional horizontal aerial which he had devised and tested during the war in Tripoli. By this method, it would be possible to secure results equal to those with a mast of great height, some two or three times the height of the Eiffel Tower; but apart from the excessive comparative cost of such a mast, engineering science has not yet proved such a construction practicable, and were it so proved it would still lack the other advantages which are derived from the more economical system of a number of smaller masts which are used for the purpose of the directional horizontal aerial.

With regard to continuous waves Mr. Marconi said:

"During 1907 I patented and developed a system for producing and utilising continuous waves, and a long series of tests were carried out at Poldhu and other places to ascertain whether it would be best to adopt continuous waves or discontinuous waves for commercial long-distance work. The result of these tests showed that the efficiency of continuous or discontinuous waves in respect to the power employed was about equal, but the discontinuous waves or intermittent waves, radiated and received in the special manner which I had devised, proved conclusively that they possessed the advantage of being far less interfered with by other stations or atmospheric disturbances. For this reason we adopted discontinuous waves for the long-distance stations which my company was erecting in Ireland, Italy and Canada. I should, however, like to make it quite clear that the system of intermittent waves adopted at Clifden and Glace Bay is by no means the ordinary spark method of 'spasmodic impulses,' as referred to by Mr. Taylor, and it is surprising to me that one who should give evidence as an expert should have so exposed his complete ignorance of anything but elementary wireless telegraphy.

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"Without going too much into technical matters, I may say that the high-speed disc dischargers which I patented in 1907 are one of the notable features of these stations, and possess the following advantages :—

"1. They cause to be radiated trains or groups of electric waves of low damping, which groups, in consequence of their high frequency and regularity, produce a clear musical note at the receiving end, which is easily distinguishable from the noises or notes produced by other stations or by the effects of free atmospheric electricity.

"2. Due to their high frequency and regularity, they also enable employment of high-speed senders and receivers, just as can be done by continuous waves.

"3. The spark gap is closed and, for all practical purposes, eliminated during most of the time in which one wishes to transfer the energy to the aerial.

"4. The primary circuit being suddenly opened, immediately quenches any further oscillations in the condenser circuit and prevents the reaction referred to by a witness, and which takes place under certain conditions between the aerial and the condenser circuit when the ordinary spark method is employed, with the result that by my disc system, instead of two bad waves, one pure wave is radiated ; but of these most important developments of my system for long-distance work neither Mr. Madge nor Mr. Taylor would appear to have any knowledge whatsoever, or if they had the knowledge they certainly abstained from mentioning it.

"In October, 1907, although I did not yet consider the stations complete, a service of Press messages was inaugurated between England and America. On February 3rd, 1908, the service was extended to ordinary commercial messages between London and Montreal. The commercial service across the Atlantic by my system has never been discontinued from that date until now, except for a few months in 1909 and 1910 in consequence of the station at Glace Bay being partially destroyed by fire. Although these stations at the commencement worked only a few hours daily, in order to allow for experiments, I found that by the end of February, 1908, about 119,945 words of Press and commercial messages were transmit ed across the ocean by this means.

"A number of interesting tests with the Clifden installation were carried out in September and October, 1910, with a view of obtaining some data as to the maximum range of that station. These tests were carried out with an Italian ship, *Principessa Mafalda*, and it was found that short messages could be obtained without difficulty by day up to a distance of 3,473 nautical miles from Clifden, the ship being then in the tropics en route for Buenos Aires. Signals were received at night from Clifden at Buenos Aires, the distance being 5,849 miles. No failures to receive at Buenos Aires at night being recorded when tests had been arranged would indicate that the night range at Clifden is greater than 5,849 miles."

Mr. Marconi next gave the following information regarding his experience in the matter of wireless telegraphy :

"I have examined and been responsible for the designs and apparatus installed on over 1,000 ships ; I arranged all the details of the wireless plant of four stations of 2,000 and more miles range—namely, Clifden, Glace Bay, Coltana, and Massaua ; and at least twenty other stations in England, America, Italy, Africa, and Spain having ranges of 1,000 miles and upwards. I have crossed the Atlantic sixty times on ships fitted with wireless telegraphy, and have closely observed the working of such stations, and have also considerable experience of the working of wireless on British and other warships, the total time I have actually been embarked on warships running into years. I have also had the rather unique experience of assisting in and being in part responsible for the organisation and working of the wireless service on behalf of the Italian Government at sea and on shore during the recent war between Italy and Turkey, for which work I have just received one of the highest honours it is possible for the Italian Government to bestow. I have travelled over a large

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portion of the Mediterranean and north coast of Africa during the hostilities, and one of the most important problems with which I had to deal was the elimination of interference or jamming, intentional or otherwise, which was constantly resorted to by the stations worked by the enemy and others, and in this work I was generally successful.

"My four sevens patent of 1900 played an all-important part in the development of wireless telegraphy. It represents what was originally known as my syntonised system, which is the simple spark system, and serves most efficiently for ship and shore and short-distance communications. From then onward I devoted myself to long-distance work, and for that purpose my system differs widely from, although it also embraces, the four sevens patent. This patent alone, however, would be totally ineffective for long-distance commercial service. My long-distance system of to-day comprises a number of important patents, several of which for their purpose I believe to be as important as my four sevens patent, and these, together with my work, experience, and knowledge, combined with that of some 200 able engineers associated with my company, added to many long years of hard work and experiment, entailing an expenditure of £360,000, which amount our long-distance experience and work have cost, constitute to my mind the right which my company had in demanding and receiving what I regard to be but very reasonable terms for the long-distance stations required by His Majesty's Government.

"In addition, however, to supplying the long-distance stations required, His Majesty's Government receives what I contend is further very valuable consideration so long as this contract remains in force—viz., the benefit of all the experience in all parts of the world, in all climates, and in all conditions, of the 200 engineers engaged in our service, and who alone represent an annual cost to my company of close upon £40,000, plus the benefit of my services, advice and inventions, for whatever they may be worth."

Mr. Marconi referred to his own and his company's dealings with the Post Office and the Admiralty. He acknowledged the courtesy and encouragement he had received from the Post Office, but denied that he had been unduly favoured; and as regards the Admiralty, he took exception to the claim that it had evolved a wireless system of its own. In September, 1911, he had inspected the wireless equipment of a British warship, and he maintained that the system in use in it was the Marconi and none other.

He next dealt with the technical points, and particularly with continuous waves, and from this part of his evidence we make the following excerpts:

"My experience in regard to continuous waves covers actual personal experience of the following methods:—

"1. My own method.
"2. The Poulsen arc.
"3. High-frequency alternators.

"In order not to take up too much of the Committee's time I might say straight away that, taking the waves themselves, there appears to be nothing to choose between the relative efficiency over long or short distances, whether the waves are continuous or discontinuous or damped. In regard to wave-tuning pure and simple, in my opinion, when using suitable receivers, tuning is better with continuous than with discontinuous waves.

"But long-distance wireless telegraphy as worked by my company is not dependent only on wave-tuning for obtaining selectivity and the elimination of disturbances, but it relies also on the selective properties possessed to a high degree by the human ear in distinguishing and differentiating various notes and sounds, and also on the fact that a receiver can be accurately tuned to the period of a succession of regular groups of waves properly timed as well as to the period of the waves themselves."

By the help of a diagram, reproduced on p. 167, he further explained this point as follows:

"The first line in the diagram shows continuous waves; the second line shows the waves divided into regular groups, and the third line shows them in irregular groups. By these last waves group tuning is, of course, impossible.

"Assuming the frequency of the waves

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is, say, 50,000 per second, if you are working on wave tuning alone, you can only tune to the period of 50,000 per second; but, assuming groups of waves succeeding each other at short and regular intervals of, say, 500 per second, you can tune your receiver also to the frequency of the groups—500 as well as 50,000 per second.

"One therefore has the very marked advantage by this system of being able to receive at two closely adjacent stations different messages transmitted by the same wave length, but each on different group tuning, without any interference the one by the other.

"It is impossible to do this with continuous waves, for obviously, they being continuous, there exist no groups to which a receiver can be tuned.

"The Marconi Company also attach considerable importance to other methods of mine contained in a patent granted in 1911 concerning the balancing of the receiver, which also tend to greatly minimise outside interference.

"It has been stated by a number of witnesses, including Mr. Madge, in his answer to question 6,310 on page 302 of the shorthand notes, that continuous waves require less power than discontinuous waves. (Mr. Madge, however, states in answer to question 5,487, on page 256, that he has no experience of continuous waves.) My personal experience obliges me to say that I am in absolute and unqualified disagreement with such an opinion.

"I may further add that there has never been submitted here or elsewhere one scintilla of evidence to prove that the continuous or undamped waves have any advantage over intermittent or feebly-damped waves for long-distance working in radio-telegraphy.

"Other workers of considerable practical and theoretical experience of wireless telegraphy are entirely in accord with me on this point. Count Arco, in a letter published in the *Electrician* of January 3rd, 1913, which I produce, goes further even than I do. He says that continuous waves require a larger amount of energy than a spark system, no matter whether the continuous waves are generated by arc or by high-frequency machine. Dr. Eccles, in the *Electrician* of January 10th, 1913, copy of which I produce, states in a long article, in which he is discussing purely wave tuning and resonance: 'The conclusion we reach is that the modern spark systems are capable of a very high standard of resonance. The room for improvement is so small that a generator of continuous waves must possess high efficiency inside the station if it is to prove more economical, as regards the prime supply of electrical energy, than the spark method.' In the same issue of the *Electrician* Mr. Llewellyn Preece concludes a letter on the point of undamped versus damped waves with this statement: 'We must conclude that the damped-wave system (that is, what has been called here the spark system) consumes 50 per cent. less energy than the undamped system, assuming equal speed of transmission.'

"Further, *Science Abstracts* of April 13th, 1912, which I produce, on page 203, paragraph 439, quotes Dr. L. W. Austin, who has been referred to in evidence as the expert adviser on wireless telegraphy to the United States Navy, as follows: 'Within the limits of the errors of observation, the ground absorption for the particular part of the country was the same in the case of the undamped and the moderately-damped oscillations.'

"The experience of the Italian Government officials in practical working of wireless telegraphy is second to none. Although the Marconi systems are officially adopted, they are in the habit of trying every other

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arrangement, which includes those devised by Poulsen, Bethenod, Moretti, and others. This is the only Government in the world which owns a long-distance station capable of communicating regularly a distance of 2,238·5 miles over land and sea, part of which distance is situated in the tropics. The Italian Government, moreover, possess more long-distance stations in actual operation than any other Government, besides eighteen coast stations for communicating with ships. Lieut.-Commander Pession, probably one of the officers who has the most practical and scientific experience of wireless telegraphy in the Italian Navy both in regard to long and short distances, in an article published in the *Revista Marittima*, issue of October, 1912, which I produce, on the subject of modern apparatus for wireless telegraphy, states in regard to the relative advantages and disadvantages of continuous and damped waves: 'It would seem that the best results should be obtained by the use of continuous waves (waves not damped or sustained waves), but one can say at once that the means which are at present known for producing them have not yet become practicable; but, on the other hand, it would appear that with the best receivers at present available it is neither economical nor useful to make efforts to employ such waves.' Count Arco, in a lecture delivered before the German Society of Naturalists and Doctors, which I produce, at their eighty-fourth annual meeting, held in 1912, comes to the conclusion that, in regard to the elimination of atmospheric disturbances or interference, discontinuous waves are very much more efficient than continuous waves. It has, I think, been generally understood by this Committee on the evidence so far given that the so-called Poulsen system is a continuous wave system. I wish to state that there is grave doubt as to whether it is anything of the kind. Professor Fleming, whose competence in the matter has already been referred to before this inquiry, in a lecture before the Royal Institution on May 24th, 1907, which lecture is reproduced in the *Electrician*, June 7th of that year, copy of which I produce, stated, referring to the Poulsen arc: 'It has been contended that these oscillations are undamped and continuous, but I can show you a remarkable experiment with a neon tube which proves that they are not always uninterrupted.' He describes his experiment, and concludes: 'It appears to me that this proves incontestably that the oscillations are not uninterrupted, but are cut up into groups of various lengths.' It might at once be said in criticism that if discontinuous waves are better than continuous waves by the evidence I adduce, Poulsen waves are discontinuous, which would be, therefore, in favour of the system; but I beg to point out, according to the researches of Dr. Fleming and others, the waves of the Poulsen system have been found to be 'cut up into groups of various lengths.' This nullifies at once any advantage of discontinuous waves, because, in order to obtain the great advantages of a discontinuous wave system, these waves should be cut up into regular groups of equal length, as I have shown in line 2 of my diagram, and not into irregular groups.

"My personal experience of the Poulsen arc has taught me that it is extremely difficult of regulation, and that the wave tends to vary continually. This variation of wave-length destroys the advantage which would be derived were the wave continuous and unvarying.

"A paper was published by K. Vollmer in the *Jahrbuch der drahtlosen Telegraphie und Telephonie*, published at Leipzig, issues of December, 1909, and February, 1910, which I produce, entitled 'On the Variations of the Frequency and Intensity of the Oscillations of an Electric Arc.' In this he discusses and describes in detail the variations which take place in the electrical waves produced by the arc method, and he states on page 249: 'These variations diminish in wireless telegraphy the distinctness of the syntonisation and the nominal effect of the current in the secondary receiving circuit.'

"I take it that it would be wrong for practical purposes to merely consider and discuss the abstract scientific question of the advantages of continuous waves. The first important point to ascertain is whether the appliances for producing undamped waves have yet reached the point of perfection in practice which is necessary

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to gain in reality the advantages claimed; secondly, to discover whether, given the means of producing the continuous waves, any advantage is gained thereby in the matter of efficiency of transmitting and receiving signals; and, thirdly, given that one be satisfied upon the question of efficiency, is it as economical?

"Lecturing before the Royal Institution on May 24th, 1907 (copy of which lecture I have produced), Professor Fleming stated in regard to the Poulsen arc:

"'No one who has worked practically with the apparatus can say that it is a simple and easy one to use. A very little want of exact adjustment causes the arc to be extinguished or else fluctuate greatly in current, and, compared with the extremely simple appliances required for spark telegraphy, the advantage in ease of working is largely on the side of the spark.'

"An interesting and practical proof of the opinions just quoted was demonstrated in a competition which was conducted by the Turkish Army in May, 1911, when the Telefunken system, the Poulsen system, and the Marconi system were in competition for the purpose of demonstrating which was the most efficient system for the Turkish Army to adopt. Trials were carried out during a period of ten days. The Telefunken system failed to get a complete message through until the last two or three days of the trial, and then only at night time; the Marconi system maintained good communication throughout the whole period; the Poulsen apparatus failed entirely; their arc blew out on the average once a minute. The Turkish Army adopted the Marconi system.

"I would draw particular attention to these tests in view of the evidence which has been given before this Committee, that the Poulsen system is believed to be more simple and efficient for short-distance communications. It is unnecessary for me, perhaps, to state that the first essentials for military stations are simplicity, efficiency, and reliability, and military stations such as these are short-distance installations.

"I must say, from my long experience of wireless telegraphy and engineering matters, that I rather hold with Commander Loring in his refusal to attach too much weight to opinions expressed by certain experts. At the Select Committee appointed in 1907 to consider the ratification of the Berlin Conference, eminent experts gave evidence on the subject, I believe, in this very room.

"Sir William Preece, F.R.S., Sir John Gavey, Engineer-in-Chief to the Post Office, and Mr. Nevil Maskelyne all stated that in their opinion the Poulsen system could be used for ships and could communicate or be made to communicate with other systems; and one of them went so far as to predict that it was likely that it would entirely supersede the spark method, and that as time goes on and the Poulsen system is extended, the number of vessels fitted with Poulsen apparatus would become more if not universal (page 182, 2,591). At that time, as far as I can ascertain, four or five ships were equipped with Poulsen apparatus, and 102 with Marconi apparatus. The Convention was ratified by Great Britain, and the alleged disabilities under which other so-called systems laboured were removed. What has been the result? According to the last official return of the systems employed on ships, issued by the Berne office (1911-12), which for the purpose of the working of the Convention represents all the Governments which signed the international agreement, there were then 803 ships fitted with the Marconi system (there are many more now), and not a single one stated to have the Poulsen system. I submit that some of the difficulties of regulation which I have referred to, and which Dr. Fleming described, have been responsible for the non-adoption of this method on ships which have to carry out a commercial service by means of wireless telegraphy, and at the same time must have apparatus on which they can absolutely rely in times of distress.

"As to what weight can be attached to the opinions hitherto given as to the amount of power required for Trans-atlantic communication, I may refer to the lecture delivered by Dr. Valdemar Poulsen at the Queen's Hall, London, November 27th, 1906, at which lecture Sir William Preece presided. At this lecture Mr. Poulsen stated that Trans-

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atlantic communication should be readily obtained by utilising a power of some 10 kw. I produce a report of this lecture. If he referred to occasional communication he was quite correct, for I had already done it with less than 10 kw., but if he was referring to constant communication, as it would appear he must have been, he must have altered his mind since, as I understand that Mr. Gandil, acting on his advice, now proposes to use 150 or 200 kw. for a distance of 2,000 miles (xxiv., page 583, 11,093), and I agree with him that he will require all this power or more if he be able to construct an arc of such a power, and, when constructed, if he can discover the means of effectively utilising that power.

"Although I have made diligent inquiry, I have failed to learn of an arc which has ever yet been constructed to effectively utilise more than 40 kw. of power.

"It is fair that I should admit that, in common with Dr. Poulsen and others, I started also with the idea that long-distance work could be conducted with small power, and it is only as a result of years of hard, active work, without any intermission, and continuous experiment, that I claim to have proved incontestably that, for an efficient commercial wireless telegraph service over long distances to meet the varying conditions of every day in the year, high power is an absolute essential.

"It is quite erroneous to come to the conclusion that the possibility of the application of continuous waves is in any way neglected by the Marconi Company. It at present possesses two methods, patented by myself, of producing and utilising continuous waves. The first is based on the employment of a discovery for producing undamped oscillations, in which discs revolving at a high rate of speed are employed. The second method is a high-frequency alternator. In regard to the first, which has been published and discussed in many technical papers and works dealing with the subject of wireless telegraphy, Professor J. A. Fleming, lecturing at the Royal Institution in 1907 (a copy of which lecture I have produced), stated as follows: 'In the production of continuous oscillations we are not limited to the arc method. Mr. Marconi has for some time past been engaged in developing an ingenious method of creating undamped electric waves for telegraphic purposes, which involved neither an arc nor alternator but is a new mechanical method of great simplicity.

"'This method is capable of producing astonishingly large alternating currents of very high frequency—in other words, so-called undamped or persistent oscillations. I have recently witnessed some of his experiments, and was surprised at the results obtained. Long distances have been telegraphically covered with every prospect of great efficiency.'

"This method was described by me before the Royal Institution, March 13th, 1908, and in my Nobel lecture, copies of which I produce. The experts who have given evidence before this Committee must either have forgotten all about these developments or have been in complete ignorance of them, for not a word did any one of them say in respect of them, yet mine was the only system of continuous waves successfully demonstrated to the Advisory Committee over a distance of 2,000 miles. [See paragraph 26 of Advisory Committee's Report, *Wireless World*, p. 161.]

"In regard to the alternator method of creating continuous waves, I think I can say that, whilst experimental work has been done with the alternator generator producing undamped waves, no evidence has been adduced to show that regular communication is taking place by the above means between any distances of the order of even 1,000 miles. The difficulties of regulation of a high-frequency alternator are very great, the variations of speed due to variations of load destroying the advantage which one could otherwise gain in wave tuning by means of the continuous waves radiated, and even if we grant that a high-frequency alternator method for the direct production of the oscillations in the sending antennæ may be an ideal system of radio-telegraphic sending, yet, nevertheless, there is no proof that the practical difficulties of construction and use have yet been overcome, and no proof that these difficulties may not yet take years to surmount, whilst

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meantime the practically operative spark system and combined spark and disc system are conducting nearly the whole of the radio-telegraphic work in the world.

"I would point out that there has been no evidence before the Committee that any high frequency alternator or so-called continuous wave system has ever yet worked for twenty-four successive hours, and I have never yet heard of any high frequency machine which has done twenty-four hours' consecutive work. I am aware that Mr. Beach Thompson has stated in evidence that he has worked between San Francisco and El Paso, a distance which he has said was 1,150 miles, but which on measurement proves to be 863 nautical miles; but I have evidence that this statement was inaccurate. A manager of the stations of the Federal Telegraph Company, which is known as the American Poulsen Company, a Mr. J. M. Harrison, who has read the evidence of Mr. Beach Thompson, states that up to the end of June, 1912, the company had never communicated directly between San Francisco and El Paso in the daytime, and that their telegrams were normally sent viâ Los Angeles and Phœnix to El Paso —that is to say, by two re-transmissions. He further states that in the summer months the El Paso station was able to work to Fort Worth only during some four to five hours a day sometimes, and viâ Kansas City to Chicago. On some days communication was altogether impossible, and the messages received from the public at El Paso were sent over the land wires. Mr. Harrison also states that automatic high-speed working was never done successfully during the two years that he was in the service of the Federal Company. I understand that Mr. Harrison has written to this Committee submitting a *précis* of the evidence which he was willing to tender, a copy of which is in my possession, and signed by him. His evidence is a direct contradiction of the answers given by Mr. Beach Thompson to questions 3,223, 3,485, 3,487, 3,848 to 3,852, 3,609, and 3,698.

"It is not new, as the Committee would have been led to suppose; it was first used by me in my Transatlantic service, in evidence of which I would refer to Dr. Erskine Murray's book on *Wireless Telegraphy*, third edition, published in 1911 On page 149 he says:

"'The interesting photograph, of which the frontispiece to this edition is a reproduction, has been given to me by Mr. Marconi as a sample of what is now done at his Transatlantic stations. It is a portion of an actual message transmitted from Glace Bay and recorded photographically at Clifden. That an automatic record can now be made over so great a distance opens up great possibilities, such as, for instance, as the employment of speeds of sending much higher than those possible when the message is read by sound and written down by hand.'

"The frontispiece of the book is entitled *The First Published Photographic Record of a Transatlantic Message.*

"This system has not been generally employed by us in our Transatlantic work as the pressure of traffic has not hitherto demanded it. We have, however, had the automatic system of transmission at work for several years at our station at Cape Cod, Massachusetts, and we are now prepared at any time when pressure of work demands to both transmit and receive across the Atlantic automatically.

"There is one further point to which I think I ought to draw the attention of the Committee, and which I cannot help feeling a little surprised was not mentioned by Mr. Madge when he took the night to consider the pros and cons of the Poulsen system. Given that the Poulsen system were of the pure continuous wave which it claims to be, and were adopted for the Imperial stations, every one of His Majesty's vessels would require some modification of its wireless plant in order to be able to receive messages from the long-distance stations. The Admiralty might see their way to carry this out, but from a strategical point of view, it would appear to me to be very important that these long-distance stations should also be able to communicate in times of stress with the British mercantile marine, and particularly with all the important liners, and there is a very large number of them. All the wireless telegraph installations on board these liners are the property of my Company, and the service on board these ships conducted by my company. I think

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too, that in his pros and cons Mr. Madge might have stated whether he had ever heard of an arc utilising more than 40 kw. of power. I do not suppose that he would suggest that arcs should be used in series for wireless purposes.

"It has been stated in evidence that my company recently endeavoured to purchase the Poulsen patents. I give an absolute denial to this statement. My company has had more than one opportunity of purchasing the Poulsen patents in years gone by, and it has not purchased them, because, in my opinion, firstly, there was no advantage to my company to use the system; secondly, had there been, there has never been any reason why we should not have developed or used the system, for I believe it is not protected by any valid patent. In support of my opinion, the German Patent Courts, for which everybody who has to do with patents has the highest respect, has declared the Poulsen master patent to be invalid and has annulled the German patent. The case was taken to the German Court of Appeal, and in November last that Court affirmed the judgment of the Court below in respect of the chief claim of the patent."

Mr. Marconi referred to some of the questions and answers given in evidence before the Committee, and concluded his evidence as follows:

"I do not wish to conclude without expressing my resentment at the reflections which have been made upon my company and upon me for having innocently entered into a contract with His Majesty's Government. I resent the inquiry into and publication given to the affairs of my company which have had no relation whatsoever to the contract entered into with His Majesty's Government, and in this respect I would particularly refer to the business carried out by Mr. Isaacs and me in America, as related by Mr. Isaacs in his evidence, which I fully endorse and confirm; and I regret that the services which my company and I have for so many years rendered to the Post Office, the Admiralty, the Mercantile Marine, and, in fact, the whole nation, should not have been deemed worthy of higher consideration."

WIRELESS STATION IN THE PANAMA CANAL ZONE

A contract has been made with the Federal Wireless Telegraph Co. (Poulsen system) for the supply and erection of a 100-k.w. wireless station at Caimito, Canal Zone, for the United States Navy. The specification called for continuous waves, and was so framed as to make it difficult for other wireless companies to advantageously tender. Moreover, the price quoted by the Federal Wireless Telegraph Co. was an exceedingly low one, only one-fourth of that quoted by the Telefunken Co. It is stated that this station will have a range of 3,000 miles. If successful it will be the first time the Poulsen system has been able to work at such ranges commercially.

In our next issue we will deal with the Poulsen system as announced at the end of this month's article entitled "The Systems of Wireless Telegraphy" (pp. 173, etc.)

"THE WIRELESS WORLD"

It has been found necessary to increase the present number of THE WIRELESS WORLD to 104 pages, to enable us to publish in full the Report of the Technical Advisory Committee in Long-distance Wireless Telegraphy. Although we have been obliged to increase the size of THE WIRELESS WORLD after only three months, we are still unable to deal adequately with the various matters that require attention, and we must apologise to our readers for having to hold over this month some of the usual features of the Magazine, and to curtail others.

An Index to Volume II. of the "Marconigraph" has been prepared, and a copy can be obtained from the Publishers, Marconi House, Strand, London, W.C., on receipt of ½d. stamp to cover postage.

Binding Cases, price 1s., by post 1s. 3d.

Bound Volumes No. II. of the "Marconigraph," price 4s. 6d.–4s. 11d.

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The "Systems" of Wireless Telegraphy

I.—THE GOLDSCHMIDT SYSTEM

By HUBERT DOBELL, M.A., A.M.I.E.E.

THE general public, reading of recent events connected with wireless telegraphy, has had its attention drawn to a number of new "systems"; and as the modern tendency—a natural one in this age of fresh marvels and constant improvement—is to assume that the things we hear about to-day are superior to the things we saw yesterday, some people have been inclined to jump to the conclusion that the Marconi system has been relegated to the background, and that it is only the start which the Marconi Company has, in point of time, that is enabling it to hold its own with the "new" systems.

If this were the case, then, indeed, the Marconi Company would be in a sorry state, and beyond doubt this would have been the case if the Company had contented itself with resting on its laurels and had occupied itself entirely by gaining such profit as it could earn with its original inventions.

But, as some Modern magnanimously remarked, "it does not follow that one's elders are *always* wrong"; and the fact is that the inventor of wireless telegraphy and his band of engineers have worked just as earnestly and with just as much skill and knowledge—to say the least of it—as the most recent of inventors of "new systems."

At the present moment, when public attention is being directed with so much interest to the various "systems," it will, we think, interest our readers to have a plain statement of facts placed before them in a form in which can be appreciated by all.

When an inventor announces that he has discovered a new system of wireless telegraphy he means that he has devised a new way of producing a certain effect which Mr. Marconi produced in his earliest experiments by sparking an insulated wire to earth—namely, the production and emission of electric waves.

No new system can claim a right to exist through the invention of a new way of "receiving" the electric waves; they must first be produced before they can be received. From time to time new "receivers" or "detectors" are invented and patented, but no new system is claimed or should be claimed for them.

What, then, is this process—the generation and emission of electric waves—which forms the basis of all "systems" of wireless telegraphy? Roughly speaking, it consists in charging-up a long insulated wire—preferably raised to a considerable height above the earth—and then allowing it to discharge to earth, charging it up again at once in the opposite direction, and again allowing the charge to escape to earth, the four processes forming a complete "cycle" of operations taking place in an infinitesimally small period of time, and one cycle following on another at a fixed and enormously rapid rate.

Each complete cycle produces one electric wave in the ether (that mysterious and little understood medium through the agency of which all such things as light, radiant heat and electric waves are transmitted), so that if the cycle is performed a million times in a second a million waves will be sent out in a second from the insulated wire into the surrounding ether.

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These waves follow one another out into space, and they all travel with the same velocity, whatever the "system" and whatever the size and shape of the insulated wire or "aerial" may be—namely, the velocity of light, which is three hundred million metres per second.

Wave-lengths and Frequencies

If we perform the above processes at the rate mentioned—a million times a second—then in one second we cause the aerial to send out a million waves, and at the end of that second those waves will be stretching from the aerial to a distance of three hundred million metres. It is clear, therefore, that by so doing we have generated waves three hundred metres in length; so we see that, in order to produce waves of any required length, all we have to do is to perform that series of operations—charging the aerial, discharging it to earth, recharging it again in the opposite direction, and again discharging it to earth—the right number of times in a second.

Tuning and Resonance

But there is a point here which must be considered. It is well known that an ordinary pendulum has a certain rate of swing of its own. If the pendulum is lengthened it will swing slower, if shortened it will swing faster. If we take a pendulum which swings naturally once to and fro in a second, and keep on giving it a little push once a second, every time it comes to the end of its swing, we shall very soon work up quite a big swing. But if we were to give it a push too often—say, three times in two seconds—or too seldom—say, twice every three seconds—some of our pushes would catch it in the wrong direction, and we should soon bring the pendulum to rest, or, at any rate, keep it only swinging slightly and irregularly. So that to set a pendulum going, and to keep it going well, it is necessary to apply a force as many times in a minute as the pendulum performs complete swings.

Now, it is found that an insulated wire such as we have mentioned and which is called the "aerial" has a period of its own, just as a pendulum has—that is to say, it wants to perform the cycle—charge, discharge, recharge in the opposite direction, and discharge again—a definite number of times in a second; and this natural period of the aerial depends—very much as it does in the case of the pendulum—on the length of the aerial, among other things.

So it is only natural to find that in order to get the best results in generating electric waves from an aerial we must perform the cycle of operations described above at a rate which agrees exactly with the natural rate of the aerial itself. When this is the case, we are said to be "in resonance" or "in tune" with the aerial.

Alternators——

For many years past machines called "alternators" have been in use all over the world for the production of electricity for lighting and other purposes. An alternator is essentially a simple form of the equally or better known "dynamo," which is, in fact, an alternator with an additional piece of apparatus called the "commutator."

An alternator produces an electric current which starts from zero, increases to a maximum value in one direction, decreases again to zero, increases to a maximum in the opposite direction, and then again decreases to zero; repeating this process again and again continually. The commutator of the dynamo has the effect of changing this "alternating" current into a current always in the same direction; such a current being useful for purposes for which the more easily obtained alternating current is of no value.

For lighting purposes, however, and for driving trains, etc., the alternating current can be used; so that alternators are machines of great commercial importance.

For lighting purposes the alternations must follow one another at a fairly rapid rate, for otherwise the lamps would show

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an unpleasant and continuous "flicker," so that alternators for lighting are made to give alternations of current at rates which are usually 50 or 100 per second.

If we took an ordinary commercial alternator, giving, say, 100 alternations per second, and connected one of its poles to the aerial wire and the other to earth, it would start charging up the aerial discharging it, re-charging it in the opposite direction, and so on, at the rate of 100 complete cycles per second. From what we have already said it is clear that if the aerial were itself designed so as to have a natural frequency of 100 per second, all would go smoothly, and there is no reason to doubt that electric waves would be given out at the rate of 100 waves every second.

But what would be the length of those waves? Following our former line of reasoning, and remembering that in one second they have to cover a distance of three hundred million metres, we see that each wave would be three million metres long.

Now it has been found by experience that an aerial will not radiate electric waves at all well if its actual length—that is, the actual length of stretched insulated wire—is less than about a tenth of the wave-length it is asked to radiate, so with such an alternator the aerial, in order to be effective, would have to be about three hundred thousand metres long—nearly 200 miles.

High Frequency Alternators

Obviously, therefore, such an alternator would be impracticable as a generator of waves for wireless telegraphy. If we could induce the machine to give a frequency a hundred times greater than its normal frequency we could be content with an aerial two miles long.

Even for the most powerful wireless stations, a length of one mile would be considered the extreme limit for the length of the aerial; so even for these big stations we should have to modify the alternator so as to give a frequency two hundred times as great as that which we took as a reasonable example for a commercial machine; that is to say, we should have to devise an alternator giving a frequency of at least 20,000 per second: while for ordinary coast-stations or ships where the aerial could only be a few hundred feet in length, the alternator would have to give a current alternating at the rate of from some hundreds of thousand times a second to a million per second.

Now some twenty-five years ago, the lighting of streets and large buildings by arc-lights, worked with alternating current, assumed a considerable importance. We have mentioned that the frequency of an alternator for ordinary electric lamps has to be fairly high to avoid "flickering." With the arc-lamps, a new trouble presented itself; with frequencies of from 50 to 100 alternations per second the arc-lamps were found to "hum" unpleasantly, and strenuous efforts were made by men like Tesla and Elihu Thomson, with many others, to produce an alternator with a frequency of some 10,000 —which would do away with the difficulty.

Even such a frequency—only one-half of that suitable for the largest projected wireless station—was found to be unattainable except on a very small scale. The power required at such a big station—for naturally big stations are only put up in order to accomplish big distances—would be measured in hundreds of horse-power; and of all the brilliant inventors working at the problem for twenty years, not one was able to produce a machine which would give more than one or two horse-power.

One of the most successful of the "high-frequency alternators" was that of Duddell, which gave a frequency of over a hundred thousand; but even this, though it carried out successfully the experiments for which it was designed, gave only a small fraction of a horse-power, and was therefore quite unsuitable for wireless telegraphy.

Theoretically, the problem presents little difficulty; the frequency of an alternator depends on the number of times in a second that the magnetic field through a coil is

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reversed; if the coils are rotating, increasing the speed of rotation increases the frequency; if the speed is fixed, increasing the number of coils increases the frequency; if both are increased together, the frequency is increased rapidly.

Nothing could be more simple.

But, practically, the difficulties are enormous.

Let us take a typical case. A frequency of 300 per second is a rather high frequency for a commercial alternator giving, say, 300 horse-power. Such an alternator might be driven at the rate of 1,800 revolutions per minute; in which case it would have the periphery of its moving-part divided into 20 "poles" wound with the coils of copper wire.

Now to get such a machine to give even a frequency of 1,000 per second, it would have to be driven at the rate of over 5,000 revolutions per minute—a dangerous speed for the heavy rotating part comprising copper wire, which is constantly liable to burst loose and cause disaster.

Even at this high speed, in order to get our minimum frequency of 20,000, we should have to multiply the number of "poles" by twenty. This means that 400 poles would have to be crowded into the periphery of the moving part. If the diameter of this latter is increased to make more room for this great number of poles, this increases the difficulties and dangers of high-speed rotation. Not only this, but a very great loss of power is caused by air friction and air churning.

Apart from such mechanical difficulties, a further and no less serious trouble is caused by the fact that iron—the material of which the magnets and cores of the ordinary commercial alternator are made, and on whose properties the efficacy of such a machine depends—begins to behave very badly when called upon to deal with such high frequencies. Its molecules get so hot in keeping up with the rapid alternations of current that a great deal of power is wasted in what is known as "hysteresis losses."

The Goldschmidt Alternator

The mechanical and other difficulties in the way of producing suitable high-frequency currents by such means as these have led to an attempt to abandon them—in part—by the inventor of the latest "high-frequency generator."

The Goldschmidt machine consists of an alternator in which the magnetic field is rotating, not mechanically, but electrically, while at the same time the armature is rotated mechanically in the field, in the opposite direction.

The result of this is to produce a frequency depending on the sum of the rates of rotation of the magnetic field and of the armature; and current at this higher frequency is carried back to the field and produces a more rapidly rotating field than the first. To this, again, is added the frequency produced by the rotation of the armature. This process is repeated several times, and, finally, the required high-frequency is reached.

A German author (F. Rusch) has described this machine as producing a medley of alternating currents, out of which only one emerges by reason of resonance.

Unluckily, there is a considerable and unavoidable loss of efficiency—that is, a waste of power—at each step, and the effect of each step on the frequency is only additive, and not multiplying. That is to say, if the frequency at the first step were 1,000 per sec., at the second step it would be only 2,000, at the third 3,000, and so on; so that to get from 1,000 frequency to our minimum value of 20,000 there would have to be so many steps and such a complication of circuits that by the time the required frequency was attained there would be no—or very little—power left to utilise for wireless telegraphy. With this machine, therefore, it is necessary to start straight

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away with as high an initial frequency as possible so as to keep the steps as few as possible ; so that once more the difficulty of danger, and loss of power through air-friction, arises, and the designer is forced to choose between two evils—a large number of steps each involving a considerable loss of power, or a high initial frequency, introducing all the difficulties and dangers of high-speed rotation.

And when he has made his choice, or compromised, he is still faced with the fact that the iron of his machine insists on behaving badly with the high frequencies, and consumes a great deal of what should be useful power.

Luckily for the development of wireless telegraphy, there is another way—totally unlike those already referred to—in which high-frequency currents of any and every desired frequency can be obtained from an initial low frequency, and that in one step and without the introduction of any iron into the influence of the high-frequency currents and without any dangers and difficulties of rotating coils of wire.

The fact that this method, in its most crude form, was the original method used by Mr. Marconi, the inventor of wireless telegraphy, does not really detract from its merit, though it may tend to prejudice some minds against it.

One of the most valuable properties of an alternating current is the fact that it can be very readily transformed " up " or " down " to a higher or lower voltage or pressure. If we desire to change the pressure of a continuous current—say, to increase it—we are led to the necessity of using the current at our disposal to produce rotation of a motor, and then getting this motor to drive another machine which will generate continuous current at the higher pressure desired. If we want still higher pressure, we must employ two or more such machines " in series," and add their effects together, but in any case each machine must be designed to give a high initial pressure ; and this, though it is possible, is by no means an easy thing to do, especially on a large scale. It usually involves the rapid rotation of a heavy armature wound with a very large number of turns of fine copper wire, and leads to some of the difficulties mentioned in connection with high-frequency alternators, with the added difficulty that the current in the windings of the machine are at a high pressure and effective insulation is difficult.

The same difficulties would arise in the production of alternating current at high pressure ; luckily, the advantage referred to as being possessed by alternating currents comes in here and avoids all these difficulties. If an alternating current at low pressure—a thing easily obtained—is passed through a coil of a few turns, wound round an iron core, it will generate another alternating current in another coil wound on the same core, and if this second coil has a greater number of turns than the first the new alternating current will be at a greater pressure than the original current. So to get any pressure we require we have only to proportion our windings properly. No rotation is necessary ; the fluctuations of the first alternating current take the place of the mechanical motion, and the coils, not being rotating, can be thoroughly insulated against the resulting high pressure by immersion in insulating oils.

Such an apparatus—known as a " transformer "—is one of the most useful, reliable, and widely used things in electrical engineering. It is largely used in various systems of wireless telegraphy for the convenient production of high voltages.

Every now and then we get correspondents writing to our " Question " column suggesting that the transformer could be relegated to the scrap-heap by the use of an alternator with a fine-wire winding of many turns rotating at a high speed and therefore generating current at a high initial pressure. These correspondents have met with transformers and taken them as a matter of

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course; then, having an inventive turn of mind, they have hit upon a way of getting the same result in another way, and this, being a new way, they are inclined to conclude must be a step forward. They do not realise that it would be actually a serious step backwards, and that if they had never seen a transformer and had had to work with a machine such as they suggest, they would have rejoiced exceedingly if, in a moment of inspiration, they had hit upon the idea of a stationary transformer which would do all that was required without any fear of breakdown or dangers of high-speed rotation.

Now, what the transformer is to the engineer who wants high pressure, the Marconi dischargers are to the wireless engineer who wants high frequencies. If the first experiments in wireless telegraphy had been accomplished by the use of high-frequency alternators, there is no doubt whatever that a newcomer who showed that he could obtain the same high frequencies without the use of rapidly rotating coils, without the complications and loss of power caused by a succession of steps, and without the use of any iron, with its attendant losses, in his high-frequency circuits, he would have been hailed as the latest and greatest inventor.

And this would be so even if his apparatus possessed the same limitations with respect to the amount of power it could give as the original method which he would claim to supplant. But if, as is the case with the Marconi dischargers, the amount of power which his apparatus could effectively use was shown to be apparently without a limit, then the chorus of approval would have been even more vociferous.

Even the primitive fixed discharger used by Marconi in his earlier work was capable of dealing effectively with about 70 h.p.; his later inventions, such as those used at Clifden and Coltano, deal regularly and effectively with over 150 h.p. when required to do so, and there is practically no limit to the amount of power which can be utilised effectively by increasing the dimensions of this apparatus.

We believe we are right in saying that the greatest power ever obtained from a high-frequency alternator for more than a minute or two is under 20 h.p.—and this after 25 years' work in the attempt to develop such a machine. From time to time attempts have been made to construct larger machines, but up to the present they have always broken down under test. The mechanical and other difficulties which we have already referred to have proved too potent.

The Early Marconi Discharger

The Marconi fixed discharger, referred to above as having dealt with 70 h.p., is perhaps the simplest piece of apparatus ever seen in an electrical station. It comprises nothing breakable and nothing which moves rapidly. In conjunction with a condenser and an inductance—apparatus common to every wireless station of whatever system—it takes ordinary alternating current at the frequency of an ordinary commercial alternator (anything from 25 to two or three hundred per second), and by one transformation changes it into high-frequency currents of any required frequency, from twenty thousand to a million per second. Moreover, it introduces no hysteresis losses in the iron for the simple reason that iron is not a necessary component of it. So even that primitive fixed spark discharger would have been hailed by the pioneers of wireless telegraphy if they had been labouring with many and many a breakdown, to get 10 h.p. or so out of a high-frequency alternator.

But the primitive Marconi fixed discharger, though it is excellent in its simplicity and efficacy, nevertheless has its weak points.

In the first place, it cannot be used satisfactorily with more than about 70 h.p., so that regular communication over very great distances is difficult; in the second

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the waves it produces die out rather rapidly, and thus the "cumulative" effect on the receiver which the best modern receivers are designed to utilise is not obtained; and in the third place, it sends out waves in groups which tend to be irregular in their spacing; that is, one group does not follow another always at the same interval.

The Modern Marconi Discharger

All these defects were in the mind of Mr. Marconi when he set about his all-important research at Poldhu, one of the results of which was the evolution of his famous disc-discharger.

In its present form this machine removes every one of the above-mentioned defects, and yet retains the strength, simplicity and absolute reliability of the old fixed discharger.

It is this machine to which we have referred above, as being able to deal with over 150 h.p., and capable of being enlarged without any difficulty so as to deal with practically any amount of power which may be required.

It produces waves which are very persistent, and therefore give the receivers a good chance to make use of the cumulative effect; and it sends these waves out in perfectly regular groups, which produce a musical note, and can therefore clearly be distinguished from the noises produced by atmospheric disturbances, and also enable the receiving circuits to be "tuned" not only to the frequency of the separate waves, but also to the frequency of the wave-groups.

It is, it is true, a rotating machine; but it rotates at a reasonable speed—the speed of a commercial alternator; and it is a strong, solid disc of steel, without any fragile windings of copper to break loose mechanically, or to "break down" electrically. Finally, it has solid bars of copper to carry the high-frequency currents, and so avoids the serious hysteresis losses found in a high-frequency alternator.

Enough, we think, has now been said to make it clear that the Marconi disc-discharger, at present in constant use on a large scale at the big stations at Clifden, Glace Bay, Coltano and Poldhu, and on a small scale at smaller stations throughout the world, is as much an advance on the high-frequency alternator (as a generator of high frequencies) as the stationary "transformer" (as a generator of high pressures) is an advance on the weird machine invented periodically by our correspondents, and referred to on page 210.

No practical engineer ever thinks of abolishing the transformer in favour of such a machine; how is it, then, that people are to be found who speak of the high-frequency alternator as if it were far in advance of anything ever invented by Marconi?

Have we omitted any material fact? Let us see what the proprietors of the latest high-frequency alternator have to say for their apparatus.

In July, 1912, we were told that the proprietors of the Goldschmidt patents were building four 200-h.p. alternators which would rotate at 8,000 revolutions per minute. By a succession of steps—each of which means a waste of power—and by a multiplication of circuits, these machines were to produce high-frequency currents suitable for long-distance wireless telegraphy.

What advantages would be presented by this machine?

It would give continuous waves.

It has long been a belief with some wireless engineers and scientific men in general that "continuous waves" were things to be sought after.

Mr. Marconi himself, it must be admitted, at one time shared in this belief. The present writer well remembers a strenuous period when each day meant from 12 to 15 hours' hard labour assisting in the search for continuous waves and their production, and still recollects with something of a thrill the telegram from Mr. Marconi, at the

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distant receiving station to which he had gone for the final test, " Entirely successful."

That was many years ago : a lot of water has passed under the bridge since then, and the praises of " continuous waves " are still sung by those who are striving to attain them.

Others, however, have gone on with the development of the persistent but non-continuous waves which experience has taught them are the best for wireless telegraphy.

It is for the production of such waves that the Marconi synchronous disc discharger is the last, and, so far as can be seen, the ultimate word.

The Marconi Continuous Wave System

The advantages of the " continuous wave " have been lately expressed so strongly that Mr. Marconi thought it wise to revive his developments in this direction, with the result that it is clearly shown in the verdict of the Advisory Committee : **" the only continuous high-frequency generator which we have yet seen tried with success over long distances is the Marconi continuous high-frequency machine."**

Obviously, therefore, if continuous waves were really superior, the Marconi Company would use them and discard non-continuous waves.

The fact that the Marconi Company does not propose to abandon its present system in favour of their continuous wave system for its Transatlantic work is due simply to the fact that " there is nothing," as Mr. Marconi expressed it in his evidence before the Select Committee, " to choose between the relative efficiency over long or short distances, whether the waves are continuous or discontinuous." This opinion is the result of actual personal experience of continuous waves generated by three systems —the Marconi system, the Poulsen arc, and the high-frequency alternator.

In another part of his evidence Mr. Marconi emphasises this : " I may further add that there has never been submitted here or elsewhere one scintilla of evidence to prove that the continuous or undamped waves have any advantage over intermittent or feebly damped waves for long-distance working in radio-telegraphy."

Mr. Marconi then goes on to deal with an important point. He says : " In regard to wave-tuning pure and simple, in my opinion, when using suitable receivers, tuning is better with continuous waves than with discontinuous waves."

Here we have the real reason for the preference of the " continuous wave." The continuous wave is no doubt very much more susceptible to accurate tuning at the receiver than the old original highly damped waves of the early Marconi transmitter, but it is only slightly more susceptible than the persistent but non-continuous waves of the Marconi disc-discharger. Now this property of very " sharp tuning " is a useful one in certain cases—where one station would be inclined to interfere with another close at hand. But the great and outstanding difficulty in wireless — and especially in long-distance wireless—is interference not from other stations but from atmospheric discharges. Sharp tuning is very effective in " cutting-out " an interfering station, because that station has a definite wave-length which is different from the wave-length which is being received. Unluckily, signals from atmospheric discharges have no particular wave-length of their own ; if they had, they would present no difficulties ; but, having no wave-length, they have to be dealt with by various other methods, the most perfect of which are those of the Marconi Company.

This fact was referred to by Mr. Marconi when he pointed out that " very weak coupling " (an attribute of very sharp tuning) " is only one of the methods employed in modern practice for avoiding atmospheric disturbance, and is by no means the one which is the most effective."

This leads us to an important and in-

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teresting point. The Marconi non-continuous system is not dependent only on "wave-tuning" for obtaining selectivity and for the elimination of disturbances. As we have already mentioned, this system sends out groups of waves following one another with absolute regularity, thus producing a musical note in the receiving telephones and enabling the receiving circuits to be tuned, not only to the wave-frequency, but also to the group-frequency.

Now, although atmospheric discharges are not suitable for "cutting-out" by wave-tuning, they are eminently suitable for cutting out by the other kind of tuning; for the most vicious "atmospheric" never thinks of disguising itself as a musical note. So, among other and important appliances for cutting-out atmospherics, this "note-tuning," as it may be called, forms a very important factor in the successful working of the Marconi system, and not only in connection with the elimination of atmospherics, but also in the production of selectivity; for, by its means, one station can be received while another, using exactly the same wave-length but a different group-frequency, can be "cut out."

Let us now consider a high-frequency alternator sending out continuous waves. If it is doing its work properly it sends a continuous stream of waves which can, it is true, be subjected to wave-tuning pure and simple, but are entirely incapable of group-tuning, for the simple reason that there are no groups, either regular or irregular. Moreover, as there are no groups to give either a noise or a musical note in the telephone receiver, in order to make signalling possible the continuous waves must be split up by some additional apparatus so as to cause audible sounds.

What is the effect if this is done at the receiving end? Obviously, an apparatus which will split up the soundless continuous waves into sound-producing groups will also split up any atmospherics into groups of the same frequency and therefore the same note; so that this misguided ingenuity will result in doing to an atmospheric what even the most malicious atmospheric would not do if left to itself—it will convert it into the same musical note as that of the signals themselves.

The other alternative is to cut up the continuous waves at the transmitting station into groups which will give a sound or a note in the receiver. That is to say, having laboured to produce continuous waves, we then have to proceed to cut them up, and make them hardly distinguishable from the waves of the Marconi disc-discharger.

It will be interesting to consider this point more fully. Let us consider two stations each sending on the same wave-length—say 6,000 metres—one (which we will call "A") on the modern Marconi non-continuous system, and the other ("B") on some continuous wave system—from a high-frequency alternator let us say.

Let us suppose, for the sake of argument, that the waves sent out from A and B are equal in strength (though here it is worthy of note that no continuous waves as yet produced have been able to vie in the matter of strength with the Marconi non-continuous waves).

This assumption is made in order that the only difference between the waves sent out in the case of A they are non-continuous, and in the case of B continuous.

The station A sends out a regular succession of groups of waves at the rate of several hundred groups in a second.

Each group consists of a certain number of waves, not all of equal strength. That is to say, the waves in a group start small, increase to a maximum, and gradually decrease till they become so small as to be negligible.

These groups, each of which "sums up" in the receiver and produces a single movement of the telephone diaphragm, follow one another at the regular intervals of a musical note, and thus cause that diaphragm to emit the same note.

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The station B sends out a stream of waves all of the same strength. That is to say—and here is the great point claimed for them—there is no waxing and waning; they are all equally strong, and should therefore "sum up" or accumulate better, resulting in better "wave-tuning." But as there is no waxing and waning, they produce no sound in the telephone receiver if they are left to themselves.

In order that the signals from B may be audible, they must be cut up into groups either at the sending or the receiving end; and from what we have said about atmospherics it is to be presumed that the process will be applied at the sending end. Let us suppose that this is accomplished by the method adopted in a demonstration of the Goldschmidt generator—the use of an alternating current to excite the field of the generator. This results in the strength of the continuous waves waxing and waning as the alternating current in the field waxes and wanes, so that a note is produced in the receiver of a frequency depending on the frequency of that alternating current. For the sake of argument, let us suppose that the note produced has a frequency of 500 per second—a good note to listen to.

Let us return to station A, and suppose that it also is sending out groups of waves at 500 frequency. That is to say, the interval between the emission of each group is 1/500 second—*i.e.*, 0·002 second.

The number of complete waves in each group depends on the rate at which the waves decay or die down; taking a very average value for this rate (decrement per whole period=0·045); and using Dr. Fleming's formula for the estimation of the number of effective waves in a train, we find that in this case there are more than 100 complete waves in each train or group. Now 100 waves of this wave-length will occupy a time of 0·002 second, which is the same as the 0·002 second which is the interval between the emission of each group. So that with the "non-continuous" waves, the time between the emission of each group is filled completely with waves which wax and wane just as the "continuous" waves do. Where, then, is the possible superiority of the latter?

Altogether, the fetish of the "continuous wave" seems to be in a bad way. The report of the Technical Committee shows no whole-hearted belief in it—"continuous waves may be somewhat more efficient than intermittent trains of waves" is hardly up to the standard of enthusiasm with which the merits of continuous-wave machines are generally extolled by their proprietors. The written opinions of Count Arco, of Dr. Eccles, and of Mr. Llewellyn Preece, which were quoted by Mr. Marconi in his evidence, go far to dispel the illusion that the "continuous wave" is a desideratum to be sought after.

At any rate, one thing is clear from the report of the Technical Committee: that the Marconi Company has in its possession a system for producing these continuous waves if it wishes for them: "the only continuous high-frequency generator," as the Committee reports, "which we have yet seen tried with success over long distances."

Let us get back to the high-frequency alternator, and particularly to the Goldschmidt machine.

It is clear, from what we have said at the beginning about the generation of waves by an alternator, that the length of the waves sent out by a high-frequency alternator of any kind depends entirely on the speed of the machine. If the machine slows down, the alternations become less rapid, and the wave-length correspondingly longer; if the machine speeds up, they become correspondingly shorter.

Any variation in speed, therefore, causes the waves sent out from the aerial to vary correspondingly in their length.

Now a very slight variation in wave-length would entirely upset all accurate tuning at the receiver, and would reduce the

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quality of even the most perfect continuous wave to the level of a crude and highly-damped wave.

With the high-frequency alternator it is apparent that the difficulty must appear.

It does. Every time that one of the "dots" or "dashes" of the Morse code is made at the transmitter the machine is called upon suddenly to give its full load. In signalling figures, for instance, the full load may be thrown on the machine for five successive "dashes," and may then be suddenly removed except for five short "dots."

The natural inclination of the machine, however well it may be governed, is to slow down in the first case, and to speed up in the second, with a corresponding disturbance of wave-length.

The wave-length of a Marconi transmitter is entirely independent of the speed of rotation of any machinery, so that this difficulty does not exist—a change of speed merely alters the musical note.

So serious is this difficulty, that the full load is kept permanently on the machine, and the dots and dashes are produced by varying the aerial wave-length so that at times it is in tune with the receiver, and at others it is so much out of tune that the receiver is not affected.

This is a simple and effective way out of the difficulty, but unluckily it means that about 40 per cent. more power is being used than if signalling were done in the Marconi way; and 40 per cent. more power means considerably more expense in fuel, without the least counterbalancing gain.

This has evidently been recognised as a somewhat serious objection, for the latest scheme of the experimenters with the Goldschmidt machine is to signal in the ordinary way, and to trust to an electric governor to keep the speed of the machine absolutely constant even when full load is suddenly thrown on it.

We have not heard that they have been successful in this.

We have referred to four machines of the Goldschmidt design which were being constructed in July, 1912.

As we said, they were each to be of nearly 200 h.p.; that is to say, they were to be about twice as powerful as the Marconi plant at Poldhu, which communicates, though not commercially, with America.

And yet the Technical Committee, nearly a year later, has to report that "except in the case of the Marconi system we did not, however, obtain any demonstration on a commercial scale, or any demonstration over a distance of even 1,000 miles."

In connection with this, it is interesting to note that the latest news of the Goldschmidt machine is that a new type is being constructed which will rotate at the rate of 3,130 revolutions per minute. That is to say, in this latest type the speed has been reduced to much less than half that of the four machines which were being made a year ago.

This new machine is to give an *initial* frequency of 10,000 per second; that is, the very frequency which we mention as having been sought after unsuccessfully for the last twenty-five years. It is only after this great frequency has been obtained by mechanical rotation that the special Goldschmidt process will be applied to it, and by three steps, each involving a loss of efficiency, steps it up to a frequency of 40,000.

It is of some interest to notice the arrangements which are being found necessary to use in connection with the working of this machine. Apparently a 500-h.p. steam-engine is to drive two dynamos of nearly 200 h.p. each, and the armatures of these machines are directly connected to a motor, which, finally drives the high-frequency alternator; the rotating part of which will have no fewer than 384 poles.

It would seem that the Marconi plan of driving the whole of the moving plant direct on one shaft from a steam-turbine is somewhat more simple and desirable.

In our next number we will deal with what is known as the "Poulsen System," and will further summarise the whole matter.

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Efficiencies in Wireless Telegraphy

By W. H. ECCLES, D.Sc., M.I.E.E.

(Second Article.)

HAVING in the May number briefly sketched and defined the various efficiency co-efficients and the parts they play in the whole process of transmission and reception, we now proceed to discuss them one by one, and to assign rough values to them. In this way we may obtain some form of comparison between the various systems so far as efficiency is concerned, but neglecting all such commercially important points as convenience, reliability and speed in working, expense in installation and maintenance, and so on.

EFFICIENCY OF GENERATION.

To begin with, we take the Efficiency of Generation of Antenna Oscillations. We have to consider (1) the ordinary spark method of generating oscillations, (2) the quenched spark method, (3) the Marconi disc-discharger, (4) the arc method, and (5) the high frequency alternator.

(1) In the ordinary spark method, alternating current at 100 or 200 volts is supplied to the primary of a commercial transformer which raises the voltage to sparking-potential. In order to measure the efficiency, a mock antenna must be constructed by connecting a non-inductive resistance in series with a condenser of the same capacity as the actual antenna, and arranging that the mock antenna may be switched on to the secondary of the oscillation transformer in the place of the antenna-earth system. The non-inductive resistance must be in a calorimeter, so that the heat dissipated in it can be estimated. Then in making an experiment, the resistance is adjusted until a hot-wire ammeter (so connected as to be included in both circuits) reads the same in the mock antenna as in the real antenna. The calorimeter measurement gives the energy delivered to the antenna in a measured time, and the reading of a wattmeter at the supply terminals gives the input to the plant.

Many measurements of this kind in various countries agree in showing that the efficiency is of the order of 10 per cent. If a suitable air-blast be applied to the spark gap, the efficiency may be raised to 20 per cent. Of course these figures vary greatly according to the amount of series resistance used in the supply circuit, and where the alternating current is generated in the station, the alternator, transformer and condenser can be tuned to the alternator frequency and the efficiency brought up to 25 per cent. It is claimed that by shaping the pole-pieces of the alternator to produce a peaky wave-form, the efficiency may be pushed higher; but we may take 25 per cent. as a satisfactory figure for this kind of plant.

(2) If the quenched-spark apparatus be tested in the same way, the efficiency is found to be much higher. This arises from the fact that the quenching of the spark stops the current from running in the primary and therefore reduces the wastage. Actual measurements by the above method by independent observers have yielded results as high as 50 per cent. Owners of quenched-spark patents claim figures of the order of 75 per cent.

(3) The rotating disc-discharger method, which has been so highly developed by the Marconi Company in the production of musical signals, especially in high-power stations, effects the same operation as the quenched spark; but it breaks the primary spark by mechanical means instead of by cooling. Its efficiency has been measured as about 50 per cent. This figure may be increased by using the air-blast in addition.

(4) In the case of the arc method, the efficiency of generation of oscillations is very low. Poulsen's own figure is 14 per cent. The efficiency of the plant is greatest when the arc is connected directly in the antenna—a very usual mode of procedure.

(5) Lastly, the high frequency alternator must be considered. The Goldschmidt form of machine has been stated to give an

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efficiency of 80 per cent. at a frequency of 10,000 per second—a frequency much below anything at present used in wireless telegraphy, and necessitating enormously long antennae; but at higher frequencies the efficiency is admittedly a much lower figure, and may be assumed as below 60 per cent. Besides the machine just mentioned, that of Alexanderson has proved itself of outstanding merit; but so far as can be gathered from published statements, the efficiencies of this and the best of the other machines in use are not more than 60 per cent. when generating even the longest waves used in wireless telegraphy.

The chief causes of the losses in these machines are the windage of the motor and the hysteresis of the iron.

The outstanding claim for high-frequency alternators is, of course, that they produce truly continuous waves, and therefore enable more exalted resonance to be obtained at the receiver. In this connection it must be noticed that when the continuous oscillations produced by an alternator are broken up in any way to produce a musical signal—as, for instance, when the field of the alternator is excited by an alternating current of acoustic frequency—the waves cease to be continuous, and they possess but slight, if any, advantage as regards resonance over those produced by the Marconi studded-disc.

Efficiency of Radiation.

Turning now to the Radiation Efficiency of Antenna, we find that all systems are in this respect more or less on a par. The total resistance of an antenna may be measured by the use of the mock antenna already described. If this is made the exact equivalent of the real antenna as regards capacity, inductance and ammeter-reading, then its resistance must be the same. For example, this kind of measurement gives with the author's antenna a resistance of about 15 ohms at the minimum—the resistance varying with the wave length to which the aerial is adjusted. But by improving the "earth," as, for instance, by laying down a generous system of earth-wires, the resistance may be reduced to 5 ohms; or if the antenna belongs to a ship station, the resistance may be brought as low as 2 ohms. Even in this last case it is doubtful if the radiation resistance is as much as 1 ohm; it may probably be taken as 0·2 ohm for an average ship antenna. It is often argued that the "electrical counterpoise" method of working, in which, instead of the earth-wires and plates, a widespread insulated network of wires parallel to the earth is used (as originally described by Lodge) gives better radiant efficiency. But the comparison has usually been made with an earthed antenna of bad design—one where the earth-wires did not stretch to a sufficiently great distance. It is obvious that in order to be effective the earth-wires must be carried outwards, branching more and more finely as they go, if possible, to ensure that when the soil is left to carry the earth-currents the density of these may be very small.

The difference between a land antenna and the equivalent ship antenna can lie in nothing but the earth resistance. Thus the radiation efficiency of an average antenna, where considerable expense has been incurred in laying earth-wires, may be only 4 per cent., while that of a ship antenna may possibly be 10 per cent., the wave-length being supposed to be not much greater than five times the length of the antenna. This fact probably accounts to a very great extent for the extensively credited belief that signals are propagated far better over sea than over land. It is not so much that the waves are propagated more efficiently, but rather that they are detached from the antenna more efficiently.*

Efficiency of Propagation.

This leads to the discussion of the Efficiency of Propagation. After that remark the first thing to notice is that the trend of evidence is to show that absorption in the surface of land or sea is comparatively small. This is seen especially well in the records of such measurements as have been made over short distances. The same statement applies to absorption in the air—it is negligible over short distances. But when we consider long-distance signalling, then—whether this is accomplished mainly by surface-waves or mainly by refraction in the upper atmosphere

* This hypothesis is interesting; its truth could be judged by comparing the range of signals from, say, a high-powered ship-set off one coast of England sending across country to a second ship off another coast to a third ship out at sea.—ED.

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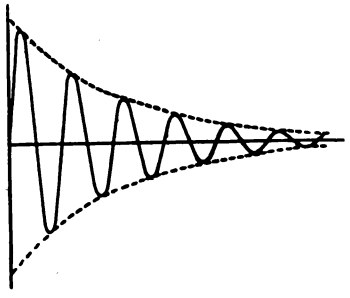
—the absorption at the upper surface of the globe or in the upper, somewhat conductive, layers of the atmosphere—as the case may be—probably becomes considerable. Accu-

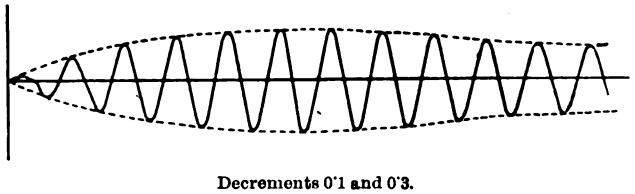


Decrement 0·5.
Fig. 1.

rate knowledge of these questions is still lacking.

Another aspect of the matter which has been somewhat to the fore recently must, however, be glanced at. Is the efficiency of propagation greater with pure sine-waves than with damped waves?

In answer to this question we may take it as mathematically obvious that the difference is negligible for telegraphic purposes. But, fortunately, it happens that some recent measurements made by the Telefunken Company by the aid of the new high frequency alternator which they are putting on the market, has rein-



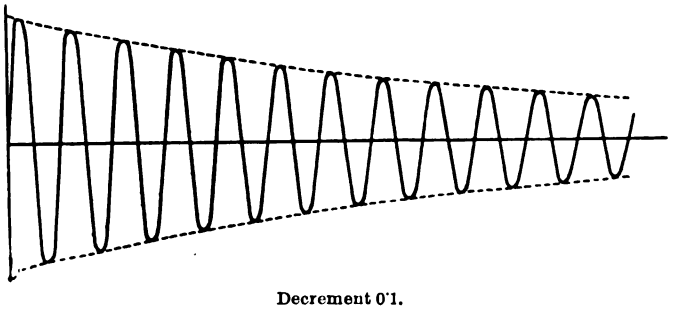
Decrements 0·1 and 0·3.
Fig. 3.

forced the verdict of commonsense on this point. Here it may be remarked that an analogous question might be asked about the radiation-efficiency; and there the answer is that from the theoretical point of view the damped waves would be slightly better than the sine-waves; in fact, the original "whip-crack" discharge might be the best of all.

RESONANCE EFFICIENCY.

We now come to the Resonance Efficiency. The resonance efficiency of sender and receiver deals directly with the question of the value of damped waves as against pure sine-waves; for the smaller the decrement of the waves reaching the receiving station the higher is the resonance effect. This has nothing to do, be it noted, with imperfection of tuning—that is a mere matter of adjustment of the receiving apparatus, and perfect tuning is assumed; it is concerned with the fact that the energy imparted to a vibrative system by another of substantially the same period is a more or less involved function of the damping of *both* systems.

In the early days of wireless telegraphy the decrements of the antennæ used were



Decrement 0·1.
Fig. 2.

very great. The vibration of an early plain sending antenna, if plotted on a time base, would appear somewhat as in Fig. 1.*

Here the decrement is 0·5 per period—a decrement built up of radiation resistance, earth resistance and spark resistance. It seems probable that even with a good earth the decrement of a plain sending antenna may still be about 0·3 per period. Similarly a receiving plain antenna, when the coherer resistance is reckoned in, possesses a very high decrement.

When tuning coils were introduced, the decrements began to assume lower normal

* [We have to thank the Editor of the *Electrician* for the loan of the three blocks used to illustrate Dr. Eccles' article.—ED. *W.W.*]

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values, and when large-capacity antennæ were used the decrements would again be reduced. It is possible that the Lodge antenna had sometimes a damping of about 0·1 per period, and consequently a vibration-curve such as shown in Fig. 2.

When tuned coupled circuits were introduced at the sending end, the train of oscillations took the form seen in Fig. 3—a form which can be represented well by supposing the oscillation to have a double decrement, one fairly large relatively to the other.

Taking the 100 per cent. resonance efficiency as that of continuous pure sine waves of perfectly uniform amplitude and period, calculation shows that the resonance efficiencies of the various types of waves mentioned are as given in the following table:

Type.	Decrements.			Resonance Efficiency per cent.
	Receiving.	Sending.		
Plain Antenna .	0.1	0.3		25
Lodge " .	0.1	0.1		50
Coupled Sending Circuit . .	0.1	0.1	0.4	60
Ditto	0.1	0.1	0.2	67
Ditto	0.1	0.05	0.1	92
Ditto	0.1	0.02	0.2	90
Continuous Waves	0.1	0	8	100

In making the comparison it is supposed that the receiving antenna is in all cases a modern plain antenna of the decrement 0·1.

EFFICIENCY OF RECEIVING ANTENNA.

Passing now to the Efficiency of the Receiving Antenna and its associated circuits, it is obvious from what has been said about the sending circuits that we are again concerned with the separation of the antenna and circuit resistance into its parts.

Looking at the matter broadly and avoiding detail, we may regard the modern coupled receiving circuits, with their variable coupling, as a mode of introducing a detector into the antenna with variable energy-absorbing power.

If the coupling is very close, a large proportion of the resistance of the detector is in effect introduced into the antenna; if the coupling is very loose, only a small portion is introduced. In the former case the enhanced resistance of the antenna will probably prevent it working up into energetic oscillation under the action of the waves; in the latter case the detector resistance is relatively so small that the detector gets an insignificant proportion of the energy of the train of oscillations on the antenna, which is thus nearly all wasted in earth-resistance and in re-radiation—though by the way a fallacy lurks here.

Between these extremes there is a best degree of coupling, where the fraction of detector-resistance effectively introduced into the antenna is not so great as to spoil the "working-up," nor so small as to lose its chance of getting a share of the energy.

It is difficult to calculate theoretically the proper closeness of coupling—largely for the reason that the variation of the coupling alters the tuning of the circuits; but practically it is easy to find the best coupling, by re-tuning the circuits to the signal-waves as the coupling is varied.

Apart from these considerations, it is necessary to insert a certain minimum of inductance in the secondary or detector circuit—a minimum which is the higher, the higher the average resistance of the detector. This is in order to provide that the detector shall have a sufficient electromotive force applied to it to allow the oscillating current through itself to be worked up.

Now it is an old principle in connection with the distribution of electrical energy as Joulean heat in circuits comprising internal (or "working") and external (or "wasting") resistances, that the working resistance ought to be equal to the wasting resistance for the former to get its greatest share.

We may fairly apply this principle here, since the circuits are tuned to the e.m.f. applied by the waves, and are therefore devoid of impedance; and hence in the case of the receiving station, the effective resistance introduced into the antenna by coupling the detector circuit to the latter ought to be equal to the sum of the radiation, earth and other resistances of the antenna. When this adjustment is made, the efficiency of the antenna and its associated circuits is about 50 per cent. From this it would appear that it does not matter how high the earth resistance is, as this would merely involve a detector of higher resistance or closer coupling. But the fallacy referred to above enters here.

Put very roughly, the re-radiation from a receiving antenna, while under the influence of electric waves, acts on the field of the waves so as to increase the energy-flow from the field to the receiver; re-radiation

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is, in fact, advantageous to a certain extent. Consequently the lower the earth resistance the better. Beyond this consideration there remains, of course, the fact that any kind of resistance in the receiving antenna impairs the resonance efficiency.

It is clear that the above-mentioned limit of 50 per cent. efficiency applies to all systems of wireless telegraphy.

DETECTOR EFFICIENCY.

The high-frequency energy now enters upon its last transformation by passing to the detector.

For telephonic reception the detectors most widely used are the point coherers, the crystal rectifiers, the electrolytic detector, the vacuum valve, and the magnetic detector.

If the wave-trains follow one another very rapidly as in some quenched-spark apparatus, as in the Poulsen arc with magnetic blast, and as in the Marconi smooth-discs, or if the waves are continuous as when high-frequency alternators are employed, a beating gold contact—called a "ticker"—is used in some one of the receiving circuits, in order to cut up the too uniform currents into pulses that can affect a telephone diaphragm audibly.

A good point-coherer can be made by oxidising thinly a clean piece of sheet iron, and adjusting a needle or a piece of wire to touch—the sheet being one pole, the needle the other, of the detector; a voltage of about 0·3 volt must be applied to put it into the sensitive state. When a train of oscillations is passed through the contact, the steady current alters temporarily, and causes a noise in the telephone receiver in the circuit; the ratio of the energy conveyed to the telephone in this way to the energy supplied in the train of oscillations is called the efficiency of the detector. For the coherer, its value is about 2 per cent. for fairly loud signals.

The crystal rectifiers usually consist of a contact between a conducting fragment of crystalline natural mineral oxide or sulphide, and a metal or another mineral. A foliated specimen of the mineral is best, especially if a blunt smooth-ended piece of metal forms one side of the contact. The reason for this is that the metal rides across the minute natural ridges of the crystal, making very numerous chisel-edged contacts, and thus achieves in effect the working in parallel of a large number of ideally fine contacts.

Such a contact possesses the property that the current produced by a given e.m.f. in one direction is many times that due to an equal e.m.f. in the opposite direction. In virtue of this property, alternating currents are "rectified"; that is to say, an alternating e.m.f. yields unidirectional current.

There may be, and generally is, some coherer action mixed up with the true rectifying action. A true coherer does not rectify in the least when no steady current is running through it. The efficiency of a given detector under wireless telegraph conditions is best measured in exactly the same way as that of the coherer.

The values which have been obtained with the zincite-chalcopyrite and the carborundum detectors are about 10 per cent. Of course, these values are for particular detectors; other detectors made of precisely the same materials may give rather different values.

The electrolytic detector, which consists of two platinum electrodes in an electrolyte, one very large and well-immersed and the other very minute and barely entering the liquid, has an efficiency very nearly the same as that of the zincite detector. The efficiency of the Fleming valve has not been measured, nor has that of the magnetic detector.

Everyone interested in wireless telegraphy must have been at times surprised at the diversity of opinion about the relative sensitiveness of the various detectors.

These differences of opinion arise partly on account of differences of material and construction, and partly because of differences in the receiving circuits. Circuits with large inductance and small capacity will give a different order of merit to a number of detectors from the order given by circuits with small inductance and large capacity, other things being the same. These statements hold good also for comparisons between the ticker and various other detectors. Some observers say the ticker is less sensitive, others say that it is more sensitive, than particular crystal detectors. Both sides may be right—much depends on the circuits, the coupling and the telephone receiver.

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TELEPHONE EFFICIENCY.

The further we go along the chain of transformations of energy, the less definite becomes our knowledge of the magnitudes of the successive energy streams.

When a rapidly-varying current passes through a telephone receiver, or through a combination of telephone-transformer and receiver, most of its energy is spent as Joulean waste in the windings, some goes in eddy-currents in the cores and diaphragm, other portions go, possibly, in hysteresis and other magnetic losses, a small portion is converted into kinetic energy of the diaphragm, and a fraction of this last is given to the air as sound waves.

Information is lacking as to the proportions. Some endeavour has been made to ascertain the proportion given to the air, by measuring the effective resistance of the instrument with its diaphragm free to move and with the diaphragm held motionless, but the smallness of the difference suggests the simile of weighing a needle in a haystack. Even if the difference is as large as 5 per cent. —which is not admitted—the amount appearing as sound—that is to say, the only useful and important part—remains still undetermined.

The best mode of approaching the matter is probably as follows:—It is known that a continuous musical sound of frequency 256 per second is just audible when conveying to the ear a stream of energy of the order of 0.4 by 10^{-6} erg per second. Now a good telephone receiver will give an audible note of 256 frequency when supplied with an alternating current of about 10^{-7} ampere, that is, with a power of 4 by 10^{-4} erg per second; but if the telephone circuit and its diaphragm happens to be "in tune" with that frequency the alternating power for just-audible sound may be only 3 by 10^{-5} erg per second.

In the former case the efficiency is 0.1 per cent., and in the latter about 1 per cent.

Our survey of the numerous transformations of energy involved in the transmission and reception of signals is now finished.

It will be seen that the least efficient transformations are those occurring at the receiving end; in fact, the conditions at the sending end are really highly satisfactory as compared with the conditions at the receiving end. At this end, then, we may hope and work for great improvement, though, indeed, it is questionable how far increase of sensitiveness of receiving apparatus ought to be pushed, so long as we are unable to prevent "strays"—*i.e.*, natural electric waves—from affecting the receivers.

It may be asked: What is the ideal minimum of power for communicating, by aid of wireless telegraphy, across a given distance? An answer may be obtained by applying simple arithmetic to the chain of efficiency co-efficients given in this article. If we take for the co-efficients, in order from the supply-circuit at the sending station, the values .5, .1,1,1, .5, .1, .01—the last being the telephone co-efficient—their product is 25 by 10^{-6}; and, therefore, if 100 per cent. efficiency were obtainable at each step, the power needed to span a given distance would be ($10^{-6} \div 25$) times less, or 40,000 times less, than is used at present.

An answer may, however, be reached by the employment of a wider view of the matter which was advocated in a paper read by the present writer in 1908.

A wireless telegraph receiver may be regarded as an elaborate extension of the operator's ear for the purpose of catching the energy passing over the site of the station —a sort of speaking- (or rather "hearing-") trumpet, in fact. The operator hears, in effect, the distant spark, although the energy does indeed travel in the form of electric and not in the form of sound waves.

Now, if we take the fact that the ear can perceive a stream of energy of the order of 0.4 by 10^{-6} erg per second, and if we make the very moderate assumption that the air-wires collect the energy from an area of wave-front amounting to one square metre, we find, on applying the inverse-square law, that a sending station using two watts (not kilowatts) ought to be audible on a flat earth at a distance of 3,200 kilometres—the distance across the Atlantic. As a fact, it is found in wireless telegraphy that something less than 20,000 times this, namely, 40 kilowatts, can be heard over the *curved* earth at the distance mentioned, under favourable conditions.

The general agreement of this estimate with that obtained by tracing the efficiencies may fairly be taken as affording some support to the numerical values we have assigned to these co-efficients.

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CORRESPONDENCE

Receivers

To the Editor.

SIR,—I should be interested to know whether any comparative tests have been made between an electromagnetic telephone and the ordinary polarised type now in use. The efficiency of a receiving station seems to depend on four components—(1) the absorption of the aerial, (2) the rectifying action of the detector, (3) the acoustic effect of the telephones, and (4) the sensibility of the operator's ear. The first two seem to have received very full consideration, whilst the last is, of course, mainly dependent on natural properties and training. Surprisingly little, however, seems to have been done towards increasing the sensitiveness of the telephones.

In the ordinary polarised telephones the pull on the diaphragm is proportional to

$$2NdN + dN^2$$

where N is the permanent pull on the diaphragm due to the polarised core, and dN the change produced by the received current. The quantity dN^2 obviously depends on the magnetic susceptibility of the core, but as it is extremely small compared with 2NdN it is generally sacrificed, and the core made of steel having low susceptibility in order to increase the value of N. If, however, the value N were produced by electromagnetic means in a soft iron core, the value of 2NdN would still be retained, but not at the expense of dN^2. By a suitable regulation of N the diaphragm should be rendered specially responsive to one-spark frequency. Makers usually advertise that their diaphragms are made to "best dimensions," but surely "best dimensions" can only be possible for a comparative short range of spark frequency? Tests with electromagnetic receivers on long distance telephone lines have given satisfactory results where the currents are small. Further, there would be no "ageing," which so often occurs due to the rough handling meted out to telephones. Has any best transformation ratio for telephone transformers used with high-resistance receivers yet been decided?

Possibly some of your readers would enlighten me on these points.

Yours, etc.,

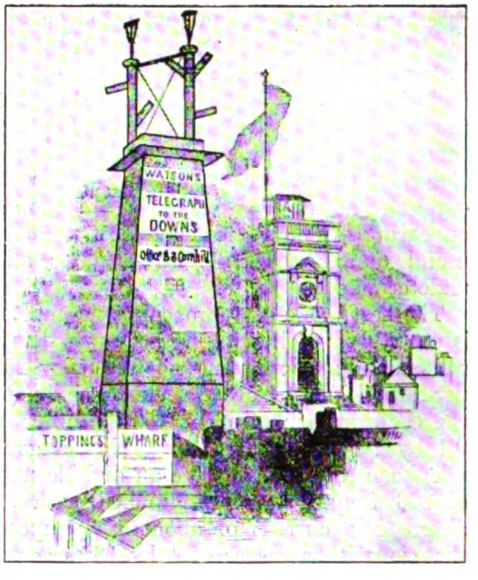
Valparaiso (Chili). C. H. K.

Semaphore Signalling

To the Editor.

SIR,—*Apropos* the article on "Signalling throughout the Ages," in your April number, the accompanying illustration and notes may be of interest to your readers.

A method of semaphore signalling was introduced by Messrs. Watson, of Cornhill, London, who erected several similar stations on the south coast of England, notably at Dover. The London station was originally an old shot factory, and served admirably for the purpose. Very little knowledge can be gleaned of the methods employed in signalling, but each station was provided with six movable semaphore arms, and



two iron braziers for the purposes of illumination at night; they followed practically the same methods of construction as the semaphore introduced into this country by Lord Murray, which was referred to in the April number of THE WIRELESS WORLD, with this difference that Watson's semaphore posts and arms were of cast iron and the whole equipment weighed ten tons. The shot tower, composed entirely of wood, was covered with slates.

Yours, etc.,

H. B. WILLIAMS.

Birmingham.

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Scenes near Wireless Telegraph Stations

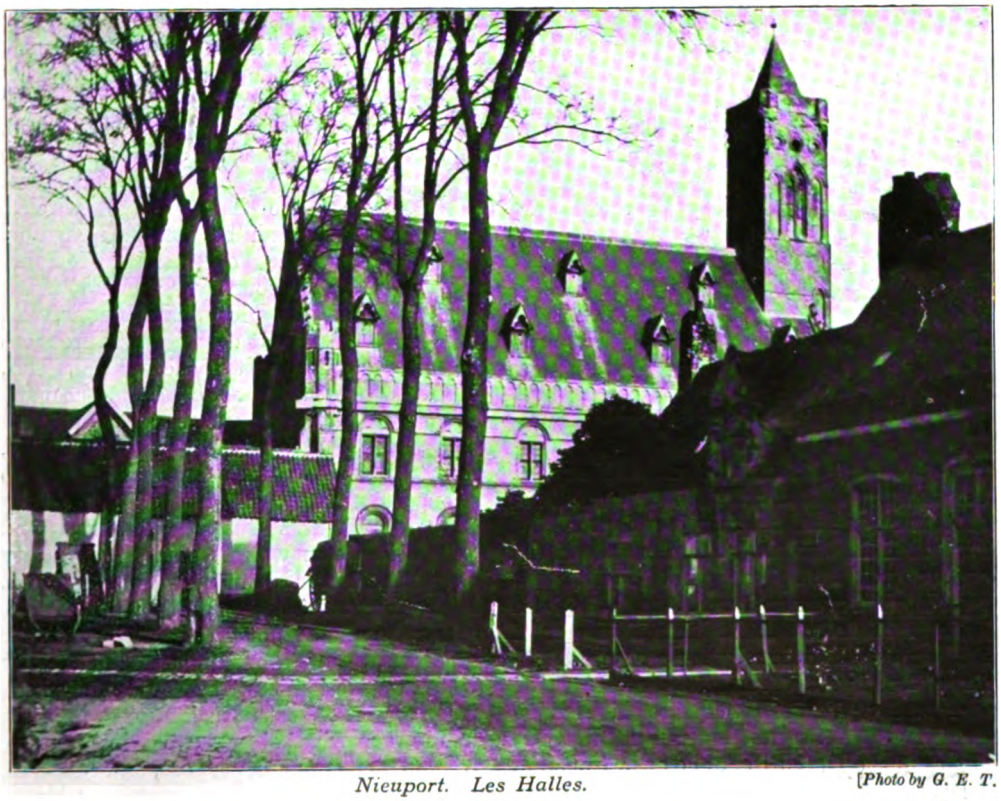
Nieuport on the "Littoral Belge"

BELGIUM was among the first countries to adopt wireless telegraphy, and considerable impetus was given by the progressive little State to radiotelegraphy generally in the creation, as far back as 1902, of the complete and thoroughly organised network consisting of the stations erected on the Dover-Ostend Packets and at Nieuport on the Littoral.

An admirable survey, historical and technical, of what was then and has since been achieved is to be found in Mr. Paul Dubois' book, "Aperçu sur la Télégraphie sans Fil," and so far as science and history are concerned we will content ourselves for the moment by merely referring to this interesting work.

But, associated with the erection of, or visit to, a wireless telegraph station in any part of the world, there are always other matters of interest, either in the adventures of the erecting engineers, in the life in the neighbourhood, or in the architectural and natural beauties of the place or its approaches.

Nieuport is rich in all these, but more especially in the remains one sees every-



Nieuport. Les Halles. [*Photo by G. E. T.*

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where of its former glory as a prosperous seaport. It was the port of Ypres when the latter ranked as an important commercial centre, and is situated on the Yser, about ten miles south of Ostend. It was strongly fortified during the turbulent middle ages, and its siege by the French in 1488–1489 is an episode of its heroic period. It was again the scene of battle in the year 1600, when Maurice of Nassau defeated the Archduke Albert of the Spaniards. Perhaps we may be permitted to make a slight digression into the past history of the country, to enable us to understand the events leading up to this important episode, which is recalled by a visit to the wireless station at Nieuport. The military skill and statesmanlike abilities of Alexander Farnese, Prince of Parma, had succeeded in bringing Belgium under the authority of Philip of Spain. Parma was appointed Governor-General in 1578, and later proceeded to make himself master of Brabant and Flanders by force of arms. In succession Ypres, Mechlin, Ghent, Brussels, and finally Antwerp fell into his hands. Thousands of its inhabitants made their homes in the Dutch Republic or in England. All commerce and history was at a standstill; grass grew in the streets of Bruges and Ghent, and the trade of Antwerp was transferred to Amsterdam. On Parma's death in 1592, the Archduke Ernest of Austria was appointed Governor-General, but he died after a short tenure of office, and was at the beginning of 1596 succeeded by his younger brother, the Cardinal Archduke Albert, who married in 1598 his cousin Isabel, eldest daughter of Philip.

[Photo by G. E. T.

An Eastern pedlar on the Strand at Nieuport.

Philip now transformed the Netherlands into a sovereign State, under the joint rule of Albert and Isabel. The advent of the new sovereigns, officially known as "the archdukes," though greeted with enthusiasm in the Belgic provinces, was looked upon with suspicion by the Dutch, who were as firmly resolved as ever to uphold their independence. The chief military event in the early years of their reign was the battle of Nieuport, in which Maurice of Nassau defeated Albert, and which led to the twelve years' truce.

But we must resist the call of history and legend made on every side, and turn reluctantly from the many famous battles that have been fought in the country now called Belgium, lest we be tempted to stray too far from that interesting town on the Yser, whose wireless telegraph station is a symbol of the commercial fortunes of the country. Nieuport is full of historical associations, and retains at every turn impressions left upon it by the Spanish. This, with the landscapes and the many interesting types of the Flemish race, and last but not least, its attractive Strand, draws every year to Nieuport numbers of artists. Once they have visited this quaint old place, and experienced the warm, genuine hospitality of its inhabitants, Nieuport is never forgotten. Its architecture, as exemplified in the types shown here, may not surpass in beauty the architecture of the famous edifices with which we are familiar elsewhere, but we can truly say of it, with Ruskin, that it is the manly language of a people inspired by resolute and common purpose, and rendering resolute and common fidelity to the legible laws of an undoubted Deity.

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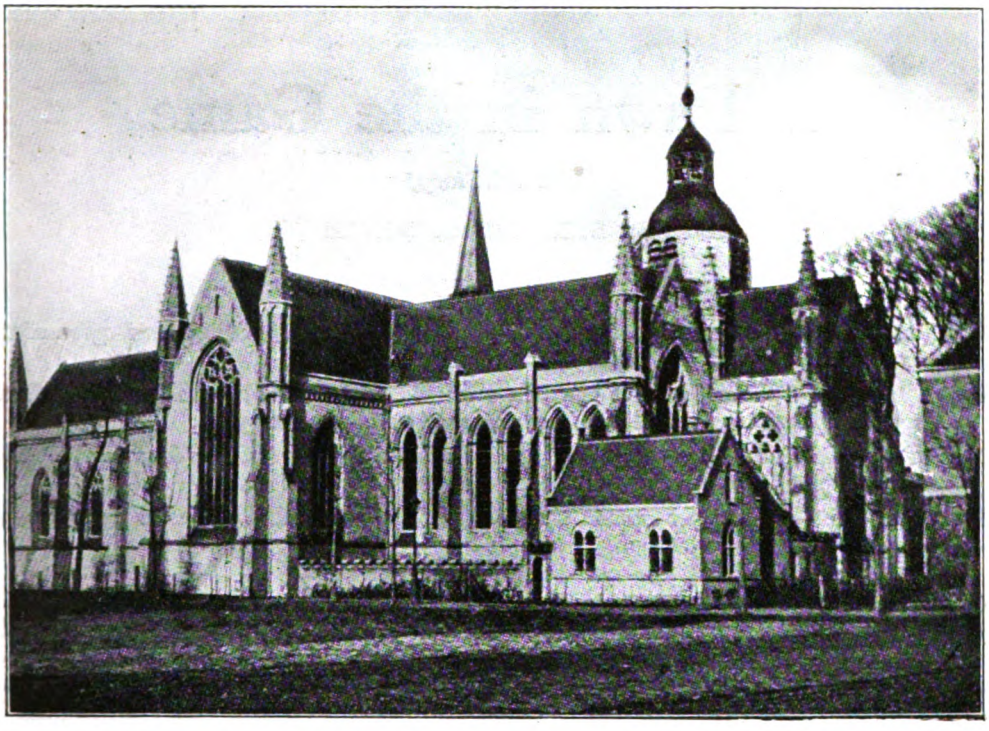

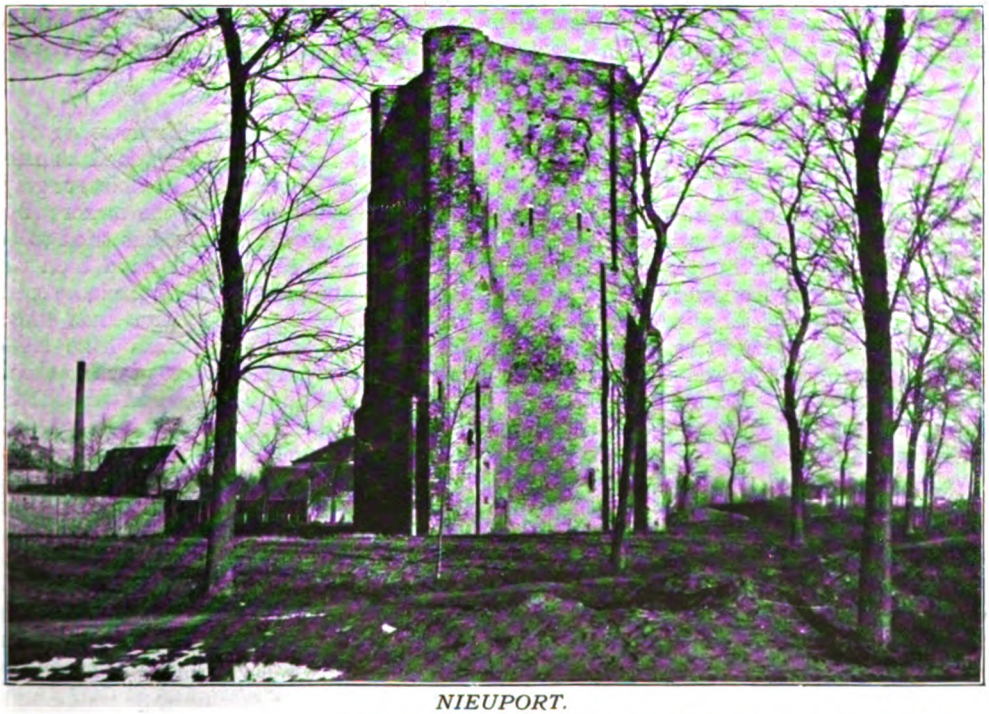

NIEUPORT.

The top picture shows a corner of the Church. The bottom, the old Tour des Templiers.
[*Photos by G. E. T.*

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire.*

GWEN THRALE.—*Charles Summers's fiancée, a bright intelligent and original girl, the idolised daughter of the squire, and secretly the member of a Fabian Society.*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly belonging to the leisured and wealthy classes with no particular aim in life.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip.*

Charles Summers, the only son of the Vicar of Sotheby, is an engineer and inventor. His peculiarities arouse comment among the villagers, and his workshop is the subject of so much curious speculation that Doss and Suk, two itinerant pedlars, make it their business to discover its secrets. They are, however, strictly warned off the premises. The only person "in the know" is Gwen Thrale, Summers's fiancée, a high-spirited girl, who often looks in to "help" him in his work. Gwen is no unsophisticated Miss; she has been a probationer at the Slade School, and is secretly a member of the Fabian Society, and in this connection has become acquainted with two foreigners, M. Dupont and Herr Buelner, who are discovered to be visiting the neighbourhood.

CHAPTER III.

GWEN OF THRALE HALL.

THIS little episode over, Summers went back to work in his den, mentally resolving that ground glass should be put into the lower window panes. He had scarcely settled again to the business in hand when Gyp began barking furiously. His outburst was followed by some quick steps on the gravel and a brisk tattoo on the door. Up jumped Charles, his face aglow with excitement, all the demeanour of the student cast away, and the spirit of the schoolboy awake again as he shouted "Coming," while he struggled into his coat. Seizing the key, he unlocked the door and flung it open wide. There, framed in the doorway, was the prettiest picture that could delight the heart of a man. A mass of soft fluffiness, a little head crowned with a mop of unruly curls which would not be domineered by hair pins, but made a riot of golden lights and ruddy shadows as they peeped out from under the broad summer hat. Eyes that were blue, or violet, or grey, according to the mood of the owner; lips that were made for kissing, but tried to be prim; a neck that would have been the despair of Juno, shown off by the loose turn-back collar of her pale blue linen dress, the skirt just allowing a neat little ankle to appear over the daintiest of white shoes. Such was Gwen Thrale, and if Charles Summers had remained unmoved at such a vision he must have had a heart of stone. But he didn't. Instead, he showed he was a young man and very ardently in love. When the first passage—shall it be called a passage of arms?—was over, he drew her into the workshop and made haste to discover a chair from under the accumulated débris of experimental science; but she, without more ado, pushed aside his tremendous calculations, and seating herself on the table began to draw circles with his

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compasses on any plane surface that came within her reach. All the time she chatted to him gossip of not the slightest interest to any but the person she addressed, scarcely waiting to receive his monosyllabic replies.

Gwen Thrale was an only child, and her father's darling. She showed it, too, not by haughtiness or waywardness, but by the wide open innocence of her blue eyes, and by an attitude of entire confidence and lack of consciousness which was her invariable characteristic. Like Charles, she too had lost her mother when she was very young; but that mother's place had to some extent been filled by a maiden aunt, her father's only sister, who had given her plenty of cossetting and affection, but who had wisely refrained) in view of her brother's passionate affection for his child and her own difficult position), from attempting to drill the little mortal to her own ideas. Had Gwen been a wilful or masterful child, this would have spelt her ruin. As it was it did her no harm, but allowed her to develop herself on her own lines, while a strong sense of humour and a naturally sweet disposition acted as the necessary correctives to her indulgent upbringing. Not that "Wen," as she called herself, was a model of all the virtues. She was a pickle in petticoats. No piece of mischief was left undone for the want of a try. How often did her poor aunt groan to see her niece descending in full career down the bannister rail, or to hear the piano shrieking in expostulation as the small lady rolled the footstool violently from one end of the keyboard to the other in her efforts to produce the maximum of sound with a minimum of effort. To the servants she was a terror. To the gardener, a hybrid between a fairy princess and a nymph. She would explore the garden holding his hand and discussing the flowers with an intelligence that made him wonder; but if the time of the early strawberries was at hand, or the prize sweet peas were in bloom, experience told him he must keep a sharp look-out over the coveted treasure, for, should his watchfulness be relaxed but for an instant, he would surely find his treasure vanished, and only the marks of little feet on the soft soil. But the limit came one day when he found his prize pumpkin, which was ready for the local show and only waited the picking, unceremoniously torn from its vine, and my lady seated cross leg on the bed vigorously hollowing it out with a kitchen knife, in order, as she said, to make a carriage for Cinderella. Poor old Ben had much to say about "them darned fairy stories," with a few supplementary remarks on the perversity of childhood. Nevertheless, when Gwen came a few days later, and asked to be lifted up to cut a bunch of grapes, the horticultural enthusiast, who, since the incident, had determinedly assumed an aloofness of demeanour in order to express his extreme displeasure, gave way ignominiously before the little golden-haired autocrat.

After that had come Gwen's school days, which for her consisted of one long campaign to escape the music mistress and thwart the evil designs of the teacher of mathematics, with an equally earnest study of French literature, French history, and French art inspired by an ardent devotion for Mademoiselle Brienne. Finally there was the "finishing off" school in Paris and home again to Sotheby, with Gwen a "young lady," heir to a considerable fortune, rather pretty, and of infinite charm.

But Gwen at this age had one pronounced idea. She wanted to see life, and was disinclined to accept the boundaries of the village as the horizon of her existence. As a matter of course she visited relatives in London, and was presented at Court, nor escaped the accompanying excitement of a season in town; but what was that to a girl who wanted to find out things for herself? True, she met a number of "good" people, but her individuality and independence of thought soon caused her to see through their fine assumption of knowledge and the shallowness of their mental outlook; so when some of her father's cousins—men of repute in the professional world—came down to spend a long holiday at Thrale Hall, she found herself in a world much more to her liking, and through them discovered a way of emancipation from the deadly routine. Why not, one of them suggested in the course of a conversation with Gwen on this topic, take up a course of sculpture at the Slade School? there were plenty of girls who did this. Why not, indeed? Why not, indeed? The more she thought of it, the more it seemed to her liking, so that the day came when she cajoled her father into giving his hesitating consent to the plan, and it was not

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long before she had established herself with friends in London and became "a Slade girl." She never once regretted her action, for her work gave her a new interest. There was so much to do, to see, to hear, to experience, that she found she was no longer obliged to make her own amusements in order to pass time away, but was swept along on the tide of strenuous effort, and learned to appreciate the exhilarating influence of ambition and the desire for progress. Not that she made a great hit in her work. She was well aware that, if anything, her ability was rather below the average, but it served as a nucleus of interest for the attraction of all the more important questions of the day. Social, political, philosophical, artistic, they all had some relationship with her occupation and had to be discussed, so that in this way the opportunity was given her of forming her own ideas on all the important issues of life.

Of course she never analysed the matter in this way. She simply "took to" the life, and there was an end of it. As a natural consequence she was soon on very friendly terms with her fellow students; they were attracted by her vitality and personal magnetism, and still more perhaps by her evident affluence; for though they would have strenuously denied the soft impeachment, Miss Thrale certainly did have money and to spare for any purpose, was it subscription dance or charity; and such a companion in a set which was as a whole unable to spend lavishly, was a consideration.

The result was, Gwen was given a rattling good time. She was taken out to all their entertainments and initiated into the Slade arcana. With her "pals" she visited places of amusement that would have horrified her elders had they known. But they did not know, while Gwen, on her part, was unaware of their reputation; and the net result was she often had an evening's innocent amusement at music-halls which ought to have been frankly indecent.

This was the lighter side of her life at the Slade; but there were other factors which brought her into touch with the deeper influences of intellectual life and social progress. In common with most youth of to-day, she was waylaid by the Progressivist—he who spells his name with a big "P," loudly proclaims a doctrine of universal discontent, and would alter the whole course of nature in twenty-four hours if he had his way. He flourishes well at art centres and at the universities, for youth is naturally rebellious and iconoclastic, and it is on these instincts that he works to bring about his effects. The result is that nearly every large centre of education is also a centre of Socialism.

But Gwen Thrale was only caught in the backwash of the progressive propaganda. Had its full significance been explained to her she would not have understood. She was too comfortably off to be anything but a hanger-on to such a movement. But it was due to this influence and the accompanying excitement of indulging in a mild form of mental gymnastics that caused her to become a member of the Fabian Society. Besides all this, her associations with such heterodox theories had a glamour of naughtiness. She daren't tell her people that she was a Fabian. Such an announcement would have brought the whole village of Sotheby, with all her uncles and aunts and cousins, buzzing like hornets about her ears. But, chiefest of all (and it was for this reason that she hesitated to make the disclosure), it would have troubled her father, who clung rigidly to the old opinions. Therefore when she wanted to attend meetings or take part in debates she had to contrive little schemes and subterfuges, and all this gave zest to the proceedings. How she did enjoy those informal meetings, to be sure, for there was plenty of mirth and pleasant society and clever talk, with a freedom from social restraint which was to be found nowhere else in social England; in fact, it was the nearest approach that England could offer to the Bohemianism of the *Quartier Latin* and the artist colony of Rome.

There she made heaps of friends, who really appreciated the girl for her naïveté and charm; and Gwen, at twenty, was not above being flattered at the delicate compliment. So it happened that when her three years of studentship were passed, and Miss Thrale was obliged to relinquish London life and take her place in Sussex society as the hostess of Thrale Hall and daughter of the Squire of Sotheby, she still managed by hook or by crook to attend the Fabian reunions, and keep up correspondence with the more intimate of her associates. Sometimes she was able to invite those who had

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the least pronounced opinions to a week's shooting or other entertainment at Thrale Hall; but the only time when she dared to introduce a whole crowd of these friends to the countryside was on the occasion of her twenty-first birthday. Then the entire village was *en fête* and prepared to enjoy itself, and Gwen thought that at such a time, and among the large company which assembled to honour the occasion, of any idiosyncrasies peculiar to such an unconventional set would pass unnoticed. Even as it was, the manners of some of them evoked the village curiosity and a certain amount of gossip, but Gwen's enjoyment outbalanced any slight difficulties of this nature. How she revelled in the picnics which took place without the accompaniment of flunkeys and hampers and champagne bottles, where plates were taboo, and lunch consisted of a few sandwiches wrapped in greasy paper bags, and stowed away in satchel or pocket! Never were dances more delightful than those improvised for the evenings, when some member of the party would rattle off tune after tune on a rather cracked old fiddle, the owner's Bible and missal and *vade mecum*, while another would thump out tunes on the piano with more goodwill than compassion for the instrument. Then, too, the boat-races on the ornamental lake, when the competing crews could only be distinguished by the Chinese lanterns they carried, and the shallows and weed-beds of the course had to be avoided more by luck than guidance. What echoes of cheering reverberated in the pine woods, and how scandalised the night owls were to hear French songs sung in good French, and sometimes, when the fun was fast and furious, the strains of the "Marseillaise!" Those *were* days! But Gwen realised that they must not come too often if the respectability of the family was to be observed. Therefore she wisely refrained from repeating the experiment, but contented herself with her occasional journeys to town, and screwed all the amusement out of life that Sotheby could afford her. Naturally circumstances threw her a good deal in the way of the vicar's son, and she did not take long to appreciate both himself and his work. He really was a jolly chap, despite his reserve, and already experience had taught her that she would have to go far afield before she could find another so genuine or with such integrity of purpose. Charles might be somewhat aloof and undemonstrative, and not altogether the *beau ideal* of a lover, but he would make a good husband, for he was sympathetic and loyal and tactful and interesting; wherefore Gwen elected to forego the poetry of love-making and be content with the gold of sincere prose, and "when," as she wrote in a letter to her favourite cousin, "Charles popped the question, she knew she had struck on a good thing, and would have been a silly to say 'No'!"

Now she was urging that good thing to accompany her into Chittingham.

"Dad is waiting outside," she said, as she jumped down from the table. "I can't keep him a moment longer. He will have finished his cigar, and then he hates waiting. Why don't you come along with us? You will be sitting over those figures until you're altogether wuzzy, and if I'm coming here this evening to help you with your work, I don't want to have to humour a bear with a sore head."

Here Summers expostulated: "I really must get on. These calculations of wavelengths are the very deuce, and I shan't feel contented till I have worked them out."

"But you will never work them out this morning. It is nearly twelve o'clock now, and by the time you have settled yourself down to them again you will be wanted for lunch."

"Well, I'll have a try, anyhow. I really must."

"Why must?"

"They've got to be done."

"I don't see that there is any got about it. The world's not going to dissolve away because you leave your calculations over for half an hour. Besides, nobody's waiting for them. You have only got yourself to please, and *me*." In answer, Charles took her arm, and Gwen knew that her case was won.

"Well, I can't stop here any longer. We've got to go and choose partridges. Dad says he won't sit down to another meal unless he can get some partridges. Here's your chance of helping me. Come and pinch the poor little corpses, and give me your opinion of them. I detest the work. I daren't leave it to the housekeeper or

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aunt. They don't know a chicken from a woodcock, and would be sure to be swindled. I don't know much myself, but I pretend I do; but if you come along old Barlow will tremble for his reputation, and we shall get the pick of his stock; and don't forget you will have to help eat them to-morrow. There now, what further inducement could you want than that?"

By this time they had reached the vicarage gates and saw Mr. Thrale in a governess cart patiently walking the pony up and down. As soon as he saw them he increased his pace, and welcomed the pair with a nod.

"Dad," called out Gwen, "Charles is as stubborn as a mule. Don't you think he ought to come with us and help choose the partridges? I have been telling him so for the last half hour!"

"Half hour!" drawled Mr. Thrale, "I should think an eternity. I have smoked two cigars and worn this beast out with walking him up and down."

"Oh, I'm sorry, dad, but it's Charles' fault; he shouldn't be so obstinate. Now then (turning to Charles), jump in, and we'll be off to Chittingham."

Still Charles hesitated. He did so want to get on with wave-lengths, but Mr. Thrale finally decided the question. "Get in," he said, "you look as though you want an airing. Why, you look as white as a ghost, and as mopy as a broody hen."

Charles got in, the fat pony was whipped up, and the party drove down the narrow lane into the high road which led to Chittingham.

Mr. Thrale immediately handed over the reins to his daughter, and she was now dexterously steering the governess cart with its ample load through the narrow and tortuous roads of county Sussex. The high hedges on either hand were white with dust and only allowed the tops of the trees to show beyond them. The country through which they drove was largely composed of plum and apple orchards, and the red globes of the fruit would gleam here and there through the heavy foliage as the sunlight caught them. Occasionally a cottage would come into view, the front garden a blaze of gaudy flowers such as the autumn loves, and as often as not their approach to such habitation would be heralded by the expostulations of a clucking hen, who, wandering into the road, discovered at the eleventh hour that this was the broad highway leading incontinently to destruction. Occasionally a road hog passed them, its long grey body gliding warily by as though it were some swift and cunning emissary of hell. The Thrale party had journeyed about a mile when such a motor was seen approaching them. There was nothing particularly striking about the car, and it would have passed unheeded had not Gwen recognised the occupants and acknowledged them. In return they raised their hats, saluting with a deference that was almost obsequious, except that their action was rather flurried. Scarcely had they passed than the car seemed to swerve as though the chauffeur had lost control of the wheel. Then it gave a great lurch and made straight for the bank, landing half overturned in a wide ditch bordering the roadway. It was easy enough to see that the party were in difficulties, and immediately Gwen drew up, while Charles jumped out and ran to offer them assistance. Gwen, too, handed the reins to her father and came to see what was the matter. By this time the two young men had got out of the motor and were busy trying to remedy matters. With the aid of their helpers they were able to drag the machine along to a place where the ditch was less deep, and then the younger of the two men once more taking his seat in the car managed to guide it out again into the road. Immediately matters had been put to rights introductions were effected. Gwen introduced Charles to them as her *fiancé*, and they were announced to him as Monsieur Dupont and Herr Beulner. The former was dark and swarthy, his intelligent head and well-cut features set off by a regular towsel of coarse black hair. The other was his exact antithesis; fair, well made and small-boned, with a pink and white complexion and smooth damp hair brushed carefully to one side of his forehead. There was nothing to distinguish him from the typical English student, and his age might have been anything from twenty to twenty-six, certainly not more. He was clean shaven, and, in fact, might have been without original sin by all the beard that was indicated on his chin. He spoke English fluently and well, with scarcely a trace of foreign accent; and this again was in striking contrast to his friend, whose speech was punctuated with all

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the eccentricities of foreign pronunciation and enriched with frequent quotations from the French. They both made profuse apologies for troubling their helpers, mildly blamed themselves for their inexperience in motor driving, and, with professions of deep obligation, resumed their journey. Gwen and Charles turned back to Mr. Thrale, who had been watching proceedings between the puffs of another cigar as he leant comfortably back in the trap. As soon as they got up to him he wanted to know all about the young men, and Gwen told him she had met them at some of her College re-unions. This reply to his enquiries did not seem to entirely satisfy that gentleman, for all he said in response was, "Um, don't loo'; like art students, anyhow," as he meditatively chewed the end of his cigar. Then they continued their journey, Charles amusing himself by watching his prospective father-in-law as he was jostled up and down in his corner of the governess cart, which trundled energetically over the country roads in a way that governess carts have. Charles smiled. He looked so luxuriously content; the immaculate white waistcoat covered an ample form, the fat round face was so rubicund and so healthy, and the short grey beard gave such an air of fatherliness to the whole. What with whiskers and moustache and beard there was little enough to be seen of Mr. Thrale's face, and his mouth, that most tell-tale of character signs, was scarcely visible. But the eyes were scarcely in accord with the rest of his appearance. At the moment they certainly looked beneficent enough for Job as they peered lazily through the half-open lids, but Summers knew how quickly they could alter. Under the influence of excitement they seemed to shrink back into his head and glowed like fire. At such times, too, his attitude would change; no longer the leisurely contented pose, but a stiffening of the muscles, a set of the shoulders which betokened a certain reserve of animal cruelty, and the lazy drawl which he usually affected would become sharp and peremptory. Summers had noted this change when the motor car had passed them, and there again was a hint in the changed tone of voice in the way he made comment on Gwen's answer to his question. Now, however, that matters were comfortable once more, he had assumed his nonchalant attitude and contented air. He was absorbed in watching the passers-by, who became more numerous as they neared Chittingham. Soon they brought up at the principal inn, and giving the horse in charge of the ostler they went to make the proposed purchases. Mr. Thrale had some business with a local builder, so left the two young people to their own devices. Then followed the shopping of partridges and other household commodities, a process in which Charles took little interest, only troubling to utter a syllable when he knew he was expected to say yes or no as the case might be.

In the course of their wanderings Gwen told him all she knew about the travellers in the long grey car. She had met them several times at the Fabian Society, and they seemed to be rich young foreigners with plenty of money to spare and all their time on their hands. She knew they were to be at the meeting on the following day, and she had no doubt they would make a special point of speaking to her. They had always been rather friendly, and this would give them an opportunity of increasing the acquaintanceship. They were good conversationalists, well read, extremely polite, and in every superficial way desirable; but she was not sure whether she liked them or not and she rather hinted that Charles' escort at this particular meeting would be appreciated; but Charles scarcely took any notice of her suggestion, passing if off as a mere expression of opinion which was not meant to be taken in earnest—besides, he was thinking of "wave-lengths"—and Gwen, whose independence was notable even amongst such independent persons as art students, refrained from pressing her point. Nevertheless, a lurking sense of uneasiness possessed her with regard to these two men. She could not account for it and told herself it was ridiculous, but in spite of all her efforts it continued to haunt her.

CHAPTER IV.

A TRIAL TRIP.

That same evening Miss Thrale came again to the Vicarage, for Charles had arranged to sail his airship on a trial trip, in order that she might see how it worked. It was about 8 o'clock, and the light was beginning to wane, when an "Halloo" brought Charles

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out from the Vicar's study. This time there was no long gossip at meeting. Charles was anxious to get to work. He switched on the electric lights in his "lab.," and soon Gwen was half hidden in a ragged old mackintosh, an essential preliminary to "messing." Then final preparations began on a vast scale. The stable boy, the under-gardener, and a choir boy who happened to be about were pressed into the service. They had already had some sort of apprenticeship under "Maister Charles'" guidance, and they were now sent to different spots in the neighbourhood with fire balloons, and well drilled with instructions as to how, when, and where to send them off. Then Miss Summers was called to witness proceedings, and the Reverend found time to lay aside his book and join the curious crowd. The housemaid discovered she had important duties to perform which brought her into the vicinity of the window, while the cook, shelling the late autumn peas under the friendly asylum of a hedge, kept one eye fixed on the movements taking place on the Vicarage lawn. Charles, who had disappeared again into his workshop, now returned bringing the instrument which was to play the title *rôle* in this little drama. With infinite care he carried the airship from its steel hangar to a tripod fixed for its reception in the centre of the lawn. Its balloon was inflated to a nicety, the steel parts and wires shone brilliantly in the setting sun, and the whole machine looked ethereally lovely in the evening glow. Carefully he placed it on the stand with the nose slightly elevated. Then with deft manipulation the machinery was set in motion, and when the miniature engines had gained sufficient power, he turned a lever, and the little vessel gave a slight shudder and then darted forward. After this it appeared to heel over on one side, but swiftly recovered itself, and as the engine began to beat rhythmically, it soared gently into the air. The lever had been placed at a slightly acute angle, and the machine was soon flying some score of feet over the watchers' heads. Then Charles rushed into his "lab.," and switching off the lights seated himself at the table in the bay window. All was in readiness for operation. The dynamo was vibrating, and the miniature crackle of the sparking gap could be heard within the silence chamber. The pressure of a lever, a little tuning, and Charles was in touch with his airship. The toy responded to the note. He pressed one of the little knobs, and the watchers on the lawn saw the vessel lean slightly forward, and then assume the horizontal, taking a course as straight as the crow flies. Now Charles was watching it from what appeared to be an adjustable telescope fitted through the roof of the studio. This machine was fixed on a swivel which responded to a little lever placed close to the operator's left hand. It worked to a nicety, and wherever the vessel went Charles could follow it with perfect ease, while by this means he obtained a clear view over an immense expanse of sky. Once more he touched a lever, and the ship swung round. Then he played—or so it seemed to Gwen, who had come to watch him—a kind of tune on the black knobs.

"What's that for ?" she asked.

"I'm going to make it describe a circle."

Sure enough the model obeyed the call. Very gradually it took the form of a curve, and finally a complete circle was described.

"Now," said the operator, "I'm going to enlarge the circle." He pressed another of the brass keys, and the vessel darted out of its former course, swung round again once more, and was soon navigating a course similar to its first, except that it was of much larger circumference.

"Now we'll do a figure of eight."

Gwen, who was standing on a chair looking through the skylight, clapped her hands as she saw the movement carried out with complete success.

"Oh, Charles, it's really fine. It's beautiful. It looks just like some great white goblin prowling about in mid-air in search of its prey."

"Well, what is it doing now ?"

Gwen only replied "Oh," for she saw the little vessel suddenly leap forward, thrust its nose up into the air, and describe a grand spiral as it mounted up and up and up.

"Oh, Charles, if you don't look out it will disappear altogether. Why, it's getting so small it only looks like a bubble. Do stop it, or turn it round, for if it gets over the pine trees, you will never be able to get it back again."

Charles laughed. "Don't worry, chicko," he said. "It's as right as rain. Why it's *got* to obey me. Look here, I've only got to tap, and it will come along as I tell it to."

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Even as he said this, the vessel in answer to his summons made a *volte-face* and swiftly returned. But Charles was now looking at his watch. It was about time for those outposts to be doing their work. Half-past nine were his instructions, and here it was to the very minute.

"Now look out, Gwen," he cried. "You're to see something worth seeing now. Something that's never been seen before, and I reckon won't be seen again unless I have the doing of it."

He was looking intently through his telescope, and the sight seemed to give him immense satisfaction, for he gave a short whistle. From behind the pine trees of the neighbouring hill came out a fire-balloon. The night was so still that it took an age to ascend, but when it got to a certain height the wind seemed to catch it, and it began to blow swiftly across the hills. Charles reached over the operating table, his long thin fingers stretched out as if to embrace all the points at one and the same time. He touched this lever, pressed that ebony key; reaching out to another switch, he made the dynamo hum the faster, and soon Gwen saw the little model racing across the sky. It passed out of sight of the skylight; so she jumped down and rushed out to the lawn. There she found all the household assembled, gaping upwards with their heads thrown well back and astonishment writ large on each countenance. They looked too funny for words; their faces silhouetted against the night—sharp nose, snub nose and roman nose, all pointing upwards, with every pair of eyes wide open as saucers. Gwen burst into a ripple of laughter, but her merriment was cut short, and she too had to assume the ludicrous posture, for as her eye followed the line of vision marked out by the others, she saw at once that great things were happening between the airship and the fire-balloon. There was no doubt about it. The race was keen, and the hunted was being swiftly overtaken. Before many minutes the bows of the ship were almost touching the balloon. Then a remarkable thing happened. Two jets of white flame flashed out from the protruding eye-sockets. The balloon burst into flame, and in a moment it disappeared completely. Then the airship returned, for all the world as if it had been some aerial pointer which had marked its quarry and then had returned to heel at the call of its master. As it came back it made another wide circle, passing behind the chimney-pots of the Vicarage. Then, as it re-appeared, it made a sharp curve, almost at right angles, its swift movement giving the watchers the idea that it had sighted the enemy. They turned to see, and there, sure enough, over the village rose another fire balloon. Like a flash the airship made directly towards it, and as it passed over their heads they could hear the faint whirr of the engines. Soon it came up with its second victim. Again there was a flash, and a second balloon was accounted for. Other experiments followed, and the results were dramatic enough to draw applause from the little crowd on the lawn. Then the performance came to an end. The machine was made to take narrowing circles in a descending flight till it hovered just above the heads of the watchers. Charles shouted to them to keep clear of the vessel, as it would be almost red-hot and likely to burn anyone unfortunate enough to come in its way. The warning was sufficient to scatter the group, and while they peered out from a safe distance the airship gradually lowered down; then quietly, as if stiff with its own exertions, it slipped on to the hangers of the stand placed ready to receive it. Now the spectators crowded round it once again, and a buzz of talk ensued.

But Gwen had disappeared into the studio, and was asking Charles such a lot of questions as to how it was all done, the why and the wherefore, that he found the only possible means of answering such a catechism was to let the fair questioner have a turn on her own account.

"Look here, I'll show you what I did. Suppose we start the thing again. It's all in working order. Wait a minute. You take this chair, and I'll set the motor going, but don't touch anything till I come back; then I'll show you what to do. It's awfully simple. The only thing is you've got to remember what stops to touch at the right time. There you are; now I won't be two tics."

Gwen waited, and presently heard the hum which told her the motor was at work again.

(To be continued.)

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The Early Days of Wireless Telegraphy

How a Chess Match was Played

ANY incident that serves to remind one of the wonderful advance made in wireless telegraphy during the past decade will be read with considerable interest. About ten years ago there were comparatively few of the mercantile vessels fitted with wireless telegraphy, and the number of shore stations were even proportionately fewer. Only a few of the ships engaged in the North Atlantic routes were equipped with wireless telegraph apparatus, and it is not surprising that messages were not very numerous. The operators on board those vessels were then by no means overworked, and they were consequently only too ready to take part in anything that tended to keep them busy and relieve the monotony of periods which would otherwise have been idle. In the early days, it was not uncommon for passengers on two vessels sailing within wireless range to play chess matches by means of wireless telegraphy. We have the record of such a match played in July, 1902, between Mr. H. J. Stembridge and Mr. H. J. Reece, officers of the s.s. *Minnetonka*, on the one side, and four passengers of the s.s. *Etruria* on the other. These vessels were at the time travelling in the same direction, and were in communication over an extended period, so that there was an excellent opportunity of the game being played. Below is a record of the moves, in a match which resulted in a win by the officers of the s.s. *Minnetonka*:

CHESS MATCH.

Match played by "Marconi's Wireless Telegraphy" between H. J. Stembridge and H. J. Baker Reese, officers of the s.s. *Minnetonka* (winners) and four passengers of the s.s. *Etruria* (Cunard Line).

	WHITE. *Etruria.*	BLACK. *Minnetonka.*
1.	P—K4	P—K4
2.	B—Q B4	B—Q B4
3.	P—Q3	Kt—K B3
4.	K R P—K R3	P—K R3
5.	Kt—Q B3	P—Q B3
6.	Q—Q2	P—Q4
7.	B—Q Kt 3	P—Q5
8.	Q Kt—K2	Castles
9.	Kt—K B3	Q—K2
10.	P—Q R3	R—Q sq
11.	B—R2	P—Q R4
12.	Q—Q sq	P—Q Kt4
13.	Castles	B—Q Kt3
14.	P—Q Kt4	P takes P
15.	P takes P	B—K3
16.	B—R3	R takes B
17.	B takes B	R takes R
18.	Q takes R	Q takes B
19.	Q—R8	Q Kt—Q2
20.	Q—R3	P—Q B4
21.	P—Q B3	Q B P takes P
22.	Q takes P	Q—Q B3
23.	P takes P	P takes P
24.	Q Kt takes P	B takes Kt
25.	Q takes B	Q—Q Kt3
26.	Q—Q Kt4	Kt—Q B4
27.	P—Q4	Q Kt takes P
28.	Kt—K5	K Kt—Q4
29.	Q—Kt2	P—Q Kt5
30.	Kt—Q B4	Q—R2
31.	Kt—K5	Q—R6
32.	Q—K2	K Kt—Q B6
33.	Q—K B3	Q—R7
34.	Q—Q3	R takes P
35.	Q takes R	K Kt—K7 check
36.	K—R2	K Kt takes Q

White Resigns.

It might be advisable to state the method of describing the moves shown in the accompanying table. Each player counts from his own side of the chessboard, and the moves are denoted by the names of the files and the numbers of the squares. Thus, when the player "White" for his first move advanced the king's pawn two squares it is described above as follows: 1. P—K1. "Black"

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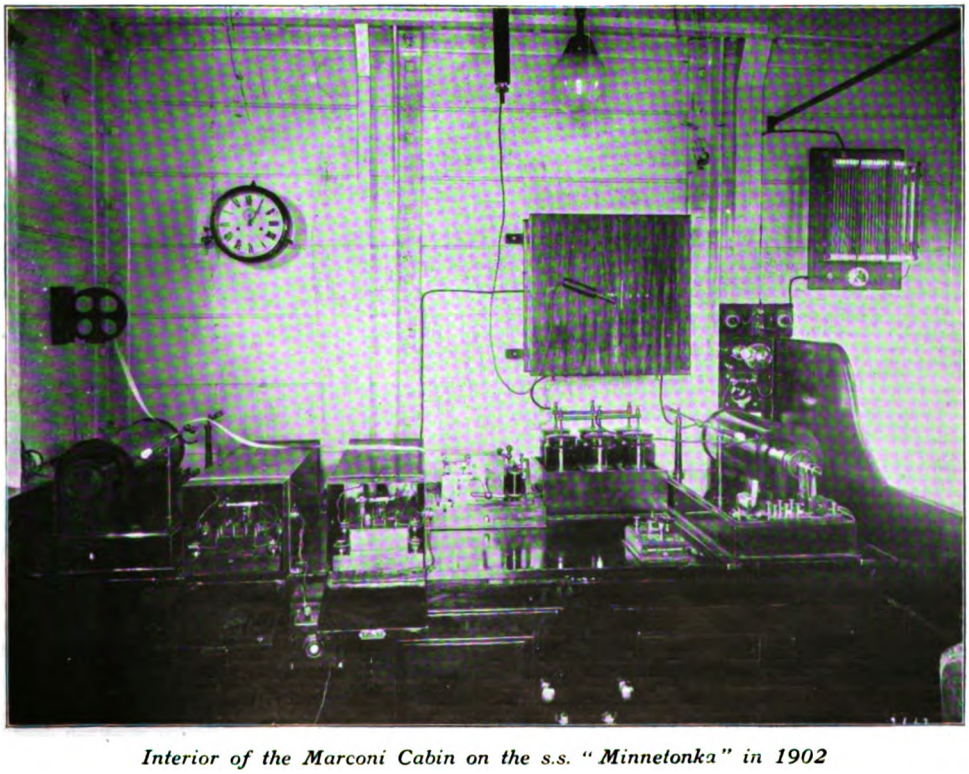
responded with a similar move from his side; next "White" moved his bishop to queen's bishop 4. The various pieces are denoted by the following letters:

K	... ...	King
Q	... ...	Queen
P	... ...	Pawn
Kt	... ...	Knight
R	... ...	Rook

K B denotes king's bishop, and Q B queen's bishop. The same applies to rooks and knights.

It is a striking testimony to the efficiency and reliability of wireless telegraphy even in the early days that a game such as chess, which abounds in subtle variations, should be played to a finish by means of wireless telegraphy with almost the same convenience as if the combatants sat face to face, each calling to his aid all that he has of foresight, brilliancy and resource both in attack and defence. We are able to show below a photograph of the apparatus on board the *Minnetonka* at the time when this chess match was played. The apparatus then in use, though differing in design from the modern types of Marconi apparatus now installed in ship stations, contained all the essentials for commercial transmission and reception of telegrams, and the modifications of following years have only resulted in improving the apparatus for its original purpose by increasing the range through increase in power and increase in size and change in shape of aerial. Dynamo-electric machinery now take the place of the coil; self-acting detectors and telephones have replaced the coherer, tapper and relay of the original receiver; selectiveness has been increased by the introduction of independent resonating circuits; these and other improvements which are now sufficiently well known to require mention here have increased the speed and certainty of working, with the result that international marine communication has grown with extraordinary rapidity on every sea and on every ocean.



Interior of the Marconi Cabin on the s.s. "Minnetonka" in 1902

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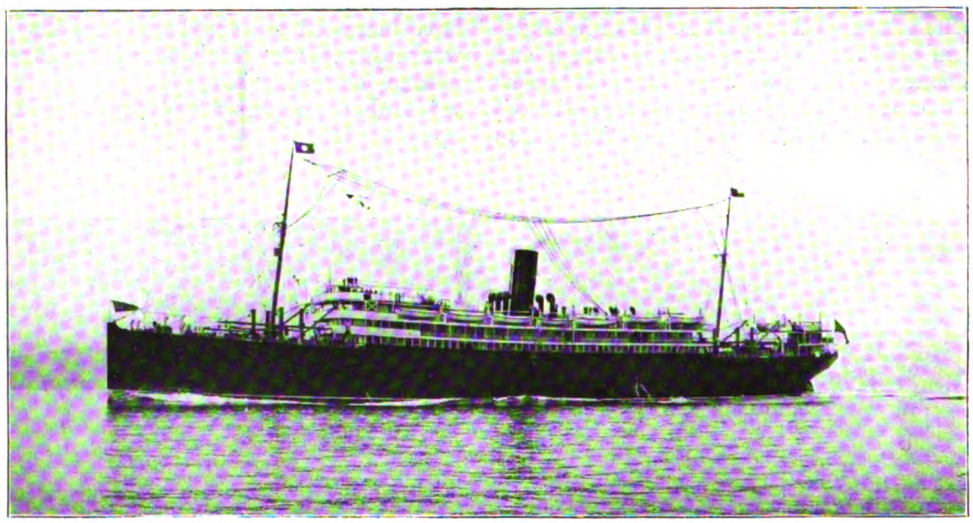
Maritime Wireless Telegraphy

AN instance of the value of wireless telegraphy to navigators is given by Captain Edward English, the representative of the Mercantile Marine Service Association, in a letter from the station at St. John's, Newfoundland, to the secretary. He reports: "I had a wireless from Captain Black of the steamer *Borderer* when he was about 350 miles from here, on a voyage from Immingham to New York, thence to China, asking about ice conditions, also the prospect of being coaled here. I replied immediately giving the desired information. He arrived on the 16th after encountering terrific weather throughout the passage. His coal supply was short, and, as there was a good deal of floating ice about, he must have had a very anxious time, for the season has been a most severe one." Then Captain English adds a note which should be appreciated by all ship masters, not only for the courtesy he offers, but for the safeguard to navigation which his offer embodies: "I mention this incident to say that at any time I shall be pleased to give information to any member of the Mercantile Marine Service Association should they find themselves in a situation similar to that of Captain Black."

* * *

The *Tamar*, which arrived at Hong Kong on May 12th, reports the reception of a wireless telegram from the Portuguese cruiser *Adamastor*. This vessel struck a rock in the north passage of Dumbell Island as she was making her homeward trip, viâ Macao, and was badly damaged, so much so that assistance was urgently needed.



The ss. "Infanta Isabel de Borbon." This vessel has been fitted with 5kw Marconi Station.

Immediately on the receipt of the intelligence the senior naval officer at Hong Kong despatched the destroyer *Otter* and the tug *Atlas* to the scene of the accident, while the Portuguese gunboat *Patria* also proceeded thither. Senhor Leiria, the Portuguese Consul, further despatched the tug *Edith*, with salvage gear, to the *Adamastor's* help at midnight. On their return from the scene of the stranding, the *Otter* and the *Edith* reported that the *Adamastor* was extensively damaged, and that her crew and war stores had been transferred to the gunboat *Patria*, but there was no loss of life.

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Instruction in Wireless Telegraphy

III. ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY.

BEFORE showing how the elementary principles of electricity and magnetism, which were explained in the last article in the May number (p. 114) are applied to wireless telegraphy, we must first explain the principles on which the science of wireless telegraphy is founded.

Let us make a simple experiment to illustrate these principles:

In a pool of water and at opposite sides of it two pieces of wood are floating. If we strike one of these pieces of wood with a hammer or in any other way cause it to disturb the water, it will be observed that a number of ripples or waves are sent out in all directions. Follow these waves until they reach the piece of wood at the far side of the pool, and it will be observed that this piece of wood is set in motion by the waves.

This is a simile of what occurs between two wireless stations. The piece of wood that is struck with a hammer corresponds to the transmitting station, the water to the transmitting medium, and the piece of wood at the far end of the pool to the receiving station.

20. **Wave Motion.**—A wave has the property of propagating itself radially from a given point, as can very easily be seen by dropping a stone into the middle of a pool of water. The displacement of the water by the stone starts a circle of ripples or waves, which circle gets bigger and bigger until either the waves die out or reach the edge of the pool. **The result is, therefore, that once a wave has been started it travels away from the point at which it was started.**

We see by the above that by producing waves we have a means of communicating signals from one part of a pond to another, and this is the principle underlying wireless telegraphy.

An interesting point to observe is that although the wave travels from one part of the pool to the other, the water itself does not do so, and, except for an up-and-down and to-and-fro motion while a wave is passing, remains where it was. This can readily be proved by placing something in the pond, such as a fishing float which lies in the water with its top just above the surface.

If a wave be started some little distance from the float, it will be seen to move up and down when the wave reaches it, but will not be carried along with the wave.

21. **Measurements of Waves.**—There are two dimensions of a wave which define its size; they are called its "amplitude" and its "length," and are shown in Fig. 1. p. 206.

The amplitude of a wave is the distance of the highest point to the normal level. and it is usually denoted by the Greek letter α (alpha).

If we notice the surface of a pond over which a wave is travelling we see that part of the wave is above the normal level of the water, and there is a corresponding depression between the crests, and a complete wave consists of the half which is above and the half that is below the level.

The length of a wave is the distance from the crest of one wave to the crest of the next, and is usually denoted by the Greek letter λ (lambda).

The waves we have been considering travel along the surface of water, but another kind of wave called **pressure waves** can be formed which travel through the body of a substance, and if the rapidity with which these waves follow each other lies between 16 and about 32,000 per second, they are known as **sound waves,** because they affect and can be detected by the ear.

The rapidity with which waves follow

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each other, or, in other words, **the number of waves that pass a given point in a second, is called the "frequency."**

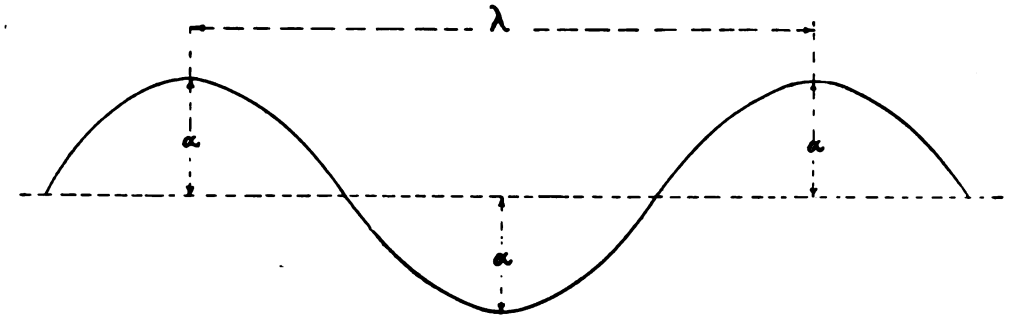
Such pressure waves obey the following important laws:

(1) For any given substance the wave travels at a definite speed, and **the speed remains the same no matter how big or how small the waves may be.**

(2) **The speed or velocity is greater the greater the density of the substance.**

Thus in air the velocity is about 1,040 feet per second, in water it is 4,700 feet per second, and in steel it is 16,400 feet per second.

(3) The amplitude of the wave very rapidly gets smaller and smaller as the wave gets further from its starting point, until, if



given sufficient room, it finally dies out altogether; in other words, **the amplitude decreases as the distance from the starting point increases.**

(4) The length of the wave—*i.e.*, the distance from the crest of one wave to the crest of the next wave, remains the same no matter how far it is from its starting point; in other words, the wave-length is constant, and is quite independent of the amplitude.

22. The next step is to consider the waves used in wireless telegraphy.

In order to explain the phenomena of light and radiant heat, physicists have imagined a substance or medium, called the "æther," and waves somewhat similar to the pressure waves we have just been considering produce rays having different properties, according to the wave-length.

The shortest wave-lengths known produce X rays, the next in length produce actinic rays causing chemical and photographic effects, then light rays and heat rays, and finally "electric" rays.

The following is a table of some of these wave-lengths*:

X-rays about 2·5 millionths of an inch.

Actinic rays of maximum intensity, 10 millionths of an inch.

Light rays from 10 to 18 millionths of an inch.

Heat rays of maximum intensity about 15 millionths of an inch.

Electric Rays shortest measured 0·24 inch. 300 feet to 30,000 feet in practical use for wireless telegraphy.

All these waves obey the laws stated for pressure waves, and the velocity of all of them is that of Light—namely, 300,000,000 metres, or about 1,000,000,000 feet per second, equal to 186,000 miles per second.

The velocity of æther waves is thus seen to be far greater than that of sound waves, and it is for this reason that, if we watch a battleship from a distance firing guns, we see the flash of the gun long before we hear the report.

The surface waves on water only partially obey the laws given above, thus the velocity depends on the wave-length—*i.e.*, big waves travel faster than small ones; further, the amplitude is not independent of the wave-length. Hence caution must be exercised when surface waves are used to explain wireless telegraphy by analogy.

At the beginning of this article we explained how, by means of waves on the surface of a pool, telegraphy could be carried out; obviously pressure waves and æther

* The one-thousandth part of the thickness of a cigarette paper is about one-millionth of an inch.

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waves can also be used in a similar manner for telegraphy, and, in fact, telegraphy or signalling is carried out by means of light waves, by using searchlights, heliographs and similar apparatus. The range, however, is small, and opaque intervening objects interrupt communication.

23. As stated above, **wireless telegraphy uses the long æther waves**, which are also known as Hertzian waves, because Prof. Hertz first experimentally proved their existence, and indicated how they could be produced by electrical means, for which reason they are also called "electric" waves. The longest wave he was able to make was about 30 feet long, but since then, by improved apparatus, such waves can be produced up to about 30,000 feet.

As already stated, these waves have the same speed as the light waves, because they are travelling in the same medium—namely, the æther.

A further condition is, however, required for the propagation of these electric waves—viz., the space in which they travel must be a non-conductor of electricity—more strictly a dielectric. The waves cannot travel in a conductor, hence they are not propagated through water, and only imperfectly through dry ground and rocks. The upper layers of the atmospheres, say, about 40 miles above the earth's surface, are also conducting, hence the electric waves produced by suitable means at the sending station travel in a sheath about 40 miles thick surrounding the earth.

In order to detect their presence at the receiving station it is necessary to have some form of detector (corresponding to the ear in the case of sound waves) which will convert these long electric waves into something which will affect one of the human senses, and which, preferably, can either be seen or heard.

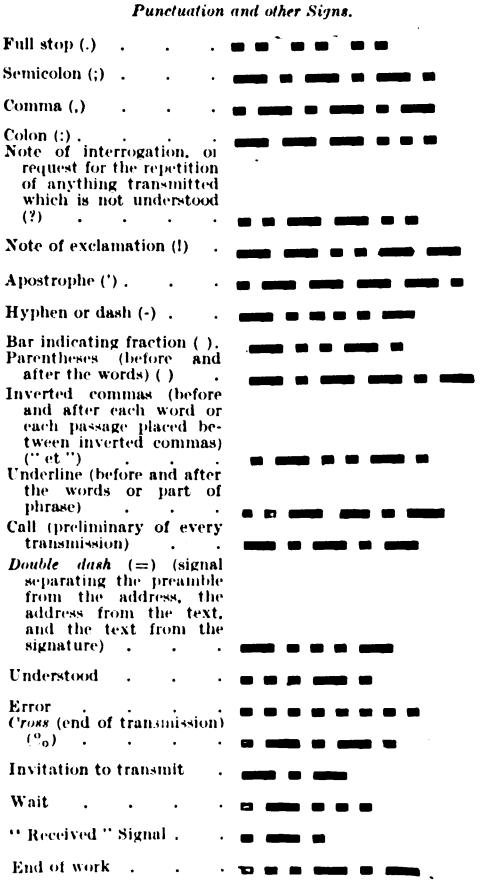
As a first step, advantage is taken of the fact that under certain conditions these waves cause an electric current to flow in a wire, and, as already described in the last article, there are many methods of detecting the presence of an electric current. We know, for instance, that when an electric current passes through a coil of wire it causes it to act as a magnet, and if this magnet is in a telephone the telephone will sound.

The foundation of wireless telegraphy is therefore an apparatus at the sending station that will produce electric waves, which are transmitted to the receiving station where their presence is made known by a "detector."

By sending a succession of such waves of long or short duration, the dash-dot of the Morse alphabet can be produced, and a system of telegraphy is thus established.

In the article which appeared in the May number, we gave the alphabet and numerals in Morse Code; below we give punctuations and general abbreviations commonly used in Morse communication.

Punctuation and other Signs.


Full stop (.)
Semicolon (;)
Comma (,)
Colon (:)
Note of interrogation, or request for the repetition of anything transmitted which is not understood (?)
Note of exclamation (!)
Apostrophe (')
Hyphen or dash (-)
Bar indicating fraction ( ).
Parentheses (before and after the words) ( )
Inverted commas (before and after each word or each passage placed between inverted commas) ("et")
Underline (before and after the words or part of phrase)
Call (preliminary of every transmission)
Double dash (=) (signal separating the preamble from the address, the address from the text, and the text from the signature)
Understood
Error
Cross (end of transmission) (+)
Invitation to transmit
Wait
"Received" Signal
End of work

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HINTS FOR AMATEURS.

A Detector and Potentiometer.

By A. L. MEGSON.

AN amateur's wireless station depends to a large extent on the efficiency of the detector. In Fig. 4 is shown a detector which will be found to give excellent results and which keeps its adjustment well. With the detector is shown a potentiometer

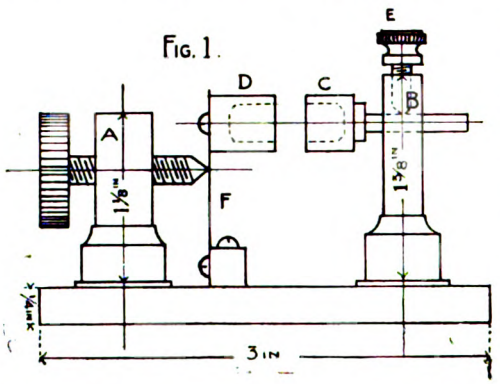

FIG. 1.

for applying through a battery a slight current through the detector. By applying this small current, signals are distinctly improved with nearly all crystal detectors, especially in picking up faint or far distant stations.

Construction.—The base is made from ebonite or hard wood, 3 in. by 2 in. and ¼ in. thick. Holes are drilled ⅛ in. diameter through the base for attaching the standards in the position shown. The foundation plates for the standards are made from thick sheet brass to sizes shown. The standard A is turned from ⅝ in. brass rod. A hole is drilled in the centre at the bottom and tapped ⅛ in. for attaching the standard to the base. The standard B is turned from

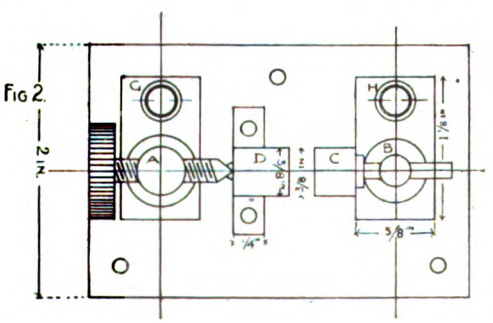

FIG 2.

½ in. brass rod, a hole being drilled and tapped ⅛ in. at each end. A hole is also drilled to enable the tag of the crystal holder C to pass through; the tag is then clamped by means of the screw E. A hole is also drilled and tapped $\frac{3}{16}$ in. through the standard A. The screw with the milled head passes through this to regulate the pressure on the spring F; this spring is made from hard brass and should be fairly stiff. Terminals G and H are screwed through the foundation plates.

The potentiometer is very simple in construction. The studs are ordinary stout pins, cut short and driven through the base of potentiometer, which is made from sheet ebonite, and projecting about half an inch underneath the base, the projecting portions of the pins being bent downwards. A brass spindle is forced through the centre and a flat reel $1\frac{3}{16}$ in. diameter and ¼ in. thick is turned

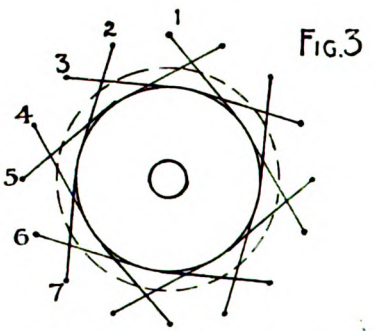

FIG.3

METHOD OF WINDING POTENTIOMETER

to fit the spindle; a groove is turned in the reel $\frac{3}{32}$ in. deep, or a little deeper. To wind, use 47 gauge S.S. covered platinoid wire. Secure one end of the wire, after baring the insulation round pin No. 1, wind round the reel clockwise three or four times, then bring to pin No. 2, and after baring the insulation, twist a few turns round the pin, then take a few more turns round the reel, but in the reverse direction, and bring to pin No. 3, and so on until the last pin is arrived at. A switch is then mounted on the top of the spindle, and this rotates on the heads of the pins, according to how much battery current is required.

To connect up, one end of the wire from potentiometer is taken to the negative terminal of battery and also to the top side of condenser; the other end is taken to the

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positive pole of battery. The centre switch is taken to one terminal of telephones, the other terminal being taken to earth side of condenser. The best battery to use is an old dry cell that has been discarded as use-

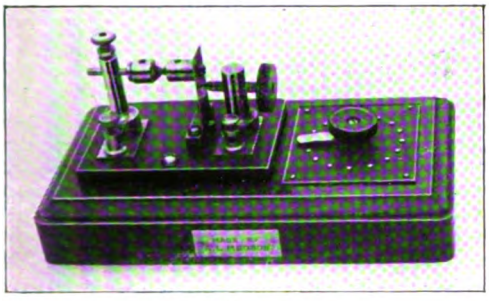

Fig. 4.

less; there is just sufficient current left in these cells to be useful. The detector and potentiometer are mounted together on a polished teak base, and if an old pocket flash-light battery is used, it can be fitted in the base.

AMATEUR NOTES.

AS an outcome of the meeting held to enlist the interest of bank officials in the national movement of Boy Scouts, Sir Edward Holden has expressed his intention of presenting a complete outfit of wireless telegraphy to the 5th Westminster Troop, which has its head-quarters at the Wesleyan Central Hall.

* * *

The usual fortnightly meeting of the Liverpool and District Amateur Wireless Association was held on May 8th. There was a very crowded attendance, and a number of new members were nominated. The members had been invited to bring some piece of apparatus for exhibition and discussion, and the request was well responded to. All present were delighted with the very interesting display. There was also Morse Code practice, elementary and advanced. A meeting of a similar character was held on May 22nd.

* * *

Another meeting of the Liverpool and District Amateur Wireless Association was held on Thursday, May 22nd. A number of new members were received. It was announced that Sir John Macpherson Grant, Bart., had agreed to become a vice-president of the Association.

* * *

The first part of the evening's programme was a wireless sending and receiving demonstration, arranged by Mr. J. Porshaw (Ormskirk). This was followed by a short lecture on "Electro-magnetism," illustrated by a number of experiments, given by a member. It was shown that every conductor conveying a current is surrounded by a magnetic field, and that such a field is proportion to the strength of the current, and varies with the current. The tangent galvanometer was also discussed, and the absolute measurement of an electric current by means of this instrument was also explained and demonstrated. On Saturday, May 31st, the members met at Seacombe Ferry for the first outing of the season.

* * *

For some time past some of the boys of Repton School, Derby, have shown considerable interest in wireless telegraphy, particularly H. Graham, who last term gave a lecture on the subject, and the chief science master, Mr. F. Brunskill, decided that its study should be encouraged. He took the matter up with the Derby Wireless Club, who undertook the fitting up of the station. The members of the club engaged on the work were Messrs. Trevelyan Lee, junr., and J. W. Downes, in consultation with Mr. S. Grimwood Taylor, the president. Mr. K. Seale Haslam, an old Reptonian, also assisted. The aerial consists of two parallel wires suspended across the ground from the science buildings to the class rooms on the west side, and is about 200 feet long. A special mast has had to be erected on the science block. The "lead-in" wires fall down to Mr. Brunskill's room, and are kept clear of the buildings by a special guy-wire.

The work was completed on May 3rd. Messages were received as soon as the instruments were attached to the aerial, Mr. Lee's portable set being used. A Derby station, "BXA," was detected communicating to "BXI," whose station is at Ruddington, in the south of Nottinghamshire.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. To enable a reply to appear in the current number such questions should reach the Editor by the 12th of the month.

S. B.—*Aerials.*—I am using a 1-in. spark-coil, and the aerial or sky-rod consists of a brass rod a yard long, attached to the transmitter balls. Could I send and receive messages over a distance of half a mile? Would the walls of the room in which it is situated, and the houses between, have any effect? Must the aerial be longer, and must it extend to the roof and the open air, and must I have more than one aerial?

Answer.—The yard-long "sky-rod" you are using is only, we fear, suitable for experiments over a few yards—say from one room to another, or in the garden. For your half-mile you had better get as great a height as you can. The shorter your aerial, the shorter will be the wave which it can radiate efficiently; and the shorter the wave the more likely is it to be impeded by walls, etc. You must try and get a height of 30 or 40 feet at least for your "free end" of the aerial. Take care that it is well insulated where it enters the house. We do not quite understand what you mean by "more than one aerial." You must certainly have one aerial at each of the two places, but there is no particular need to have more than one at each place; a single wire aerial will probably be good enough, and can be used, by means of a change-over switch, for receiving as well as for transmitting. Make sure that you have got a really good earth-connection.

M. V. asks particulars in connection with a portable sending and receiving station using a 200-metre wave, a ½-inch spark coil, and a 30-foot mast.

He asks, among other things, whether the "umbrella" type of aerial would be most suitable, or whether the use of another mast, 10 feet high, in conjunction with the 30-foot one, would improve matters.

With regard to the last point, for general "all-round" use the umbrella type would be the best. On the other hand, an inverted L aerial, with the lower mast at the "free" end, would give a very directional aerial if long enough in comparison with its height, and might therefore be very useful for certain purposes.

With regard to the bulk of his queries, they fit in very well with the well-known "knapsack" station turned out by the Marconi Company, and he will find an interesting description of this and other portable stations in the book entitled "Portable Wireless Telegraph Stations," obtainable at Marconi House, Strand, at the price of 2s. 6d.

A. H. V. B.—*Coil Winding.*—How much black enamel wire should I want to wind a tuning coil 7 inches long and 6 inches diameter; size of wire, No. 28?

Answer.—Everyone who starts experimenting in "wireless" should make up his mind to obtain one of the innumerable "pocket books" which are brought out to provide certain data for engineers and electricians. Such books are brought out in all sizes and at all prices, and they all give particulars about wires of various standard gauges. Even if they do not happen to give the actual sizes of black enamel wire, they give the sizes of the bare wire, and the weight per mile, etc., and once this is known, it is a matter of simple arithmetic to find out roughly how many turns, and therefore what weight, of the wire will occupy a given length of coil. If you want to make any progress in experimental work in wireless or in anything else, you MUST find out things of this sort for yourself.

J. A. C. wants to simplify the Marconi magnetic detector by doing away with the permanent magnets, clockwork and moving band, replacing all this by a weak cell or thermopile so connected as to pass a constant current through the ordinary primary winding of the detector, and using a simple fixed iron core. He says: "Then the cell's current would keep the core magnetised to a certain fixed standard, but when an impulse came from the aerial it would change this standard and set up a current in the secondary which would work the 'phones."

He suggests that there is something wrong with this idea, but cannot see where the flaw lies. This is due to the fact that he has not quite grasped the principle on which the magnetic detector works; the whole crux of which lies in the movement of the iron band, which is constantly bringing fresh and unmagnetised iron into the magnetising influence of the permanent magnets, and then carrying it on, by the force of the clockwork, beyond that influence. Owing to "hysteresis" (see Glossary in the "Year book of Wireless Telegraphy and Telephony" just published) the moving iron refuses to give up its magnetism without a struggle, as it were; and as the clockwork drives it further and further from the field of the permanent magnets, we may picture the magnets trying to drag back the iron, and the iron trying to drag forward the field of the magnets. When signals arrive and pass through the primary winding which surrounds the moving band just where the struggle is going on, they destroy some of the "hysteresis"—that is, they weaken the iron's power to struggle against being robbed of its magnetism; with the result that it "lets go" of the field, which slips back towards the position it would have occupied if the band were not moving through it. In slipping back, the field cuts through the secondary winding and produces a current in this, and therefore in the telephones. It is clear from this description that the action of the magnetic detector depends entirely on the movement of the iron band. In the arrangement suggested by J. A. C., the constant magnetising force of the constant current would magnetise the constantly-fixed iron core to a constant extent which would be quite unaffected by the arrival of signals.

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1791. C. S. S.—*Resistance Telephones.*—What resistance telephone receiver (single) is most suitable for receiving most commercial stations, including Poldhu, Cleethorpes, and Eiffel Tower; also that of a double telephone receiver? Is a double receiver better than a single receiver; and if so, why?

Answer.—It depends entirely upon the effective resistance of the crystal or other detector which is being used. The total resistance of the telephones should be about the same as that of the detector, when this is possible. For all-round work with various crystals, a total resistance of about 3,000 or 4,000 ohms is very suitable.

A double receiver is better in all cases, partly because most people are slightly more acute of hearing with one ear than with the other, and the best ear is unconsciously used in a double receiver. Moreover, the relative acuteness of the ears is inclined to vary from day to day, though this is by no means always the case. Some operators depend almost entirely on one ear, which is much more acute than the other; in their case it would probably pay them to concentrate all the windings of the telephones on to that one ear, and use the other part of the headpiece merely as a dummy to cover up the other ear and prevent external sounds from interfering. In the case of an operator with two ears of more or less equal acuteness, there is probably some additive physiological effect in the brain by which the signals heard by each ear add up and produce maximum effect. If a single receiver is used, it is clearly an advantage to have a dummy on the other ear to keep out the external noises.

H. L. N.—*An Example.*—We propose to take your letter as an example, and make some remarks about it to which we shall refer other correspondents when necessary. We hope you will not take it amiss that your letter should be chosen for dissection; it merely happens to contain several points to which attention would have to be called sooner or later.

The first point we would call attention to is the fact that it is written on both sides of the paper, and that paper ordinary folded note-paper. No business or scientific communication should ever be written on both sides of the paper, and the paper itself should preferably be in large sheets—either foolscap size, or at least the size of a sheet of note-paper opened out flat. In the second place, you ask far too much; a full answer to your letter would approximate to the size and value of a small text-book on Wireless Telegraphy. One long question, or perhaps two short ones, is the most we can offer to deal with from one correspondent at a time.

In the third place, you are infinitely too vague. What is an aerial of the Lodge-Muirhead type? If there is one aerial particularly associated with that name, it is the one composed of conical metal vanes, one vane for the aerial and the other for the balancing capacity; but in your case you speak of an earth connection, so you cannot mean that. You say it is 9 feet by 18 feet, hung 45 feet from the ground, but close to a slate roof. What does "close" mean? Then it is connected to a tuning inductance—maximum inductance quite unmentioned; from all you tell us, the maximum wave-length of your aerial circuit may be some hundreds of feet, while the waves of any of the big stations you refer to are measured in thousands or tens of thousands of feet. You very rightly give us the diameter of the former on which the primary of your "jigger" is wound, but you leave us in blank ignorance as to the number of turns, so that it might have a maximum value of a few microhenries, or of a few thousands. The same thing applies to your description of your jigger-secondary. The knowledge that it is wound on an 11-inch sieve is really not sufficient to suggest to us how many microhenries of inductance it represents. Across it is shunted a variable condenser of ·001 microfarads maximum capacity. You are better, here, than some people who write and tell us they are using a "small" or a "large" condenser, and if only you said what was the inductance of the jigger-secondary, we should really have something to go on, and should be able to guess whether you were tuned to a wave-length some hundreds of times too small or too long for the stations you wish to receive. We note with pleasure that you have adopted a really sensible way of connecting your receiver: here you are very much better than many of our correspondents. At the same time we must call your attention to the fact that to get the best results you must experiment with the particular detector you are using, and modify your circuits to suit it. Most high-resistance detectors are "potential-operated," and work best with as small a condenser as is possible across the jigger-secondary; so that—as that condenser has to form, with that secondary, a circuit tuned to the incoming wave—the secondary must be made long so as to have a large inductance. In such a case, the jigger-primary should only be coupled to the secondary at one end—namely, the end to which the crystal is NOT connected. Half your troubles would be removed if you would take the advice which we have repeated over and over again—USE A WAVE-METER. An experimenter in wireless, who goes about without a wave-meter and asks for advice to get him out of his difficulties, is as bad as a man who writes to *Nature* asking for the latest map of the heavens to be sent him because he cannot see some of the stars he has heard of—without trying the effect of a telescope. We do not like the shape of your "Admiralty" aerial—by the way, why "Admiralty?" The only type of aerial associated with the Admiralty, so far as we know, is the "bird-cage" type made up of a large number of wires spaced round a series of hoops of some kind. Yours, so far as the two wires are concerned, seems to be the ordinary "twin" aerial used by the Marconi Company on most of their ship-stations; though in shape it is original, and probably not very effective. We should be inclined to try an aerial stretched between the mast on the top of the house and as high a branch as possible of the trees shown in your picture, taking the down-lead off from the house-end, but not too near the house, and into a window at the bottom of the house. If this is impossible, try doing away with the lower branch of your aerial altogether, or combine it with the upper branch to form a quadruple aerial, and lead in to your window from the house-end. The rest of your letter asks for constructional details: these you must either wait for in THE WIRELESS WORLD, as such articles appear from time to time, or you must look for them in one of the many handbooks on such matters. You will find reviews of such books in THE WIRELESS WORLD, and in back numbers of the *Marconigraph*. One final word: you have no possible right to use gas-pipes as an earth-lead, and if you apply them to this use for your transmitting set, we run the risk of never hearing from you again.

[THE EDITOR REGRETS THAT OWING TO LACK OF SPACE REPLIES TO A NUMBER OF QUESTIONS MUST BE HELD OVER TILL NEXT MONTH.]

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Contract News

The Société Anonyme Internationale de Télégraphie sans Fil of Brussels have equipped the following vessels with 1½ kw. and emergency gear during the past month: *Murjek*, *Torne*, *Kiruna*, *Sir Ernest Cassel*, *Vollrath Tham*, *Kalix*, *Morrbotten*, *Abisko*, and *Malmberget*.

* * *

All these vessels belong to the Rederi Aktiebelagt Luca, of Ofoten. They are employed in the iron trade between Narvik, Norway, and Rotterdam, and are all vessels of considerable size. This company is besides completing and buying several new ships, all of which are to be fitted with the 1½ kw. wireless sets. Another vessel fitted is the *Noorderdyk Nasm*, of Rotterdam.

The following vessels have been equipped with Marconi Apparatus during the past month.

Owners.	Name of Vessel.	Installation.	Remarks.
British India S.N. Co. ..	s.s. *Angora*	1½ kw. and emergency set	Trading in Eastern waters.
,, ,, ..	s.s. *Egra*	,,	Travelling in Eastern waters.
,, ,, ..	s.s. *Ekma*	,,	
,, ,, ..	s.s. *Malda*	,,	
Larrinaga & Co.	s.s. *Jose de Larrinaga*	,,	For service between the West Indies and the United Kingdom.
,, ,, ...	s.s. *Niceto de Larrinaga*	,,	For service between the West Indies and United Kingdom, chiefly visiting Cuba.
The Johnson Line	s.s. *Rowanmore* ..	,,	Passenger vessel travelling between Brindisi and Egypt.
Alfred Holt & Co.	s.s. *Nestor*	,,	Passenger between Glasgow and Sydney, New South Wales.
The Royal Mail Steam Packet Co.	s.s. *Monmouthshire*	,,	Engaged in regular services to South America, visiting West Indies, Pacific ports, New York, Bermuda, Morocco, Spain.
,, ,, ,,	s.s. *Carmarthenshire*	,,	
,, ,, ,,	s.s. *Oruba*	,,	
,, ,, ,,	s.s. *Tagus*	,,	
The Union S.S. Co. of New Zealand	s.s. *Aparima* ..	,,	For service between America and Australasia.
,, ,, ,,	s.s. *Wahine* ..	,,	
Furness, Withy & Co. ..	s.s. *Rappahannock* ..	,,	Engaged in general trade: no fixed destination.
,, ,, ...	s.s. *Shenandoah* ..	,,	
Norfolk and North American S.S. Co.	s.s. *Eagle Point* ..	,,	Being part of an order to equip this line of steamers. They are engaged in North Atlantic service.
,, ,, ,,	s.s. *Start Point* ..	,,	
,, ,, ,,	s.s. *East Point* ..	,,	
The White Diamond S.S. Co.	s.s. *Sagamore* ..	,,	Engaged in general trade.
J. P. Corry & Co.	s.s. *Star of Scotland*	,,	Passenger between Australia and New Zealand.
The Atlantic Transport Line ..	s.s. *Minneapolis* ..	,,	These vessels have been refitted with the latest type of apparatus. They carry passengers, and have an important transport service between England and New York.
,, ,, ,,	s.s. *Minnehaha*	,,	
,, ,, ,,	s.s. *Mesaba* ..	,,	Chiefly engaged in North American transport.
,, ,, ,,	s.s. *Michigan* ..	,,	Chiefly engaged in North American transport, but carrying limited number of passengers.
The Cunard Line	s.s. *Pannonia*	,,	—
The Allan Line, Ltd.	s.s. *Carthaginian* ..	,,	
,, ,, ...	s.s. *Numidian* ..	,,	
,, ,, ...	s.s. *Grampian* ..	,,	Part of an order to refit this fine fleet of passenger boats, which were among the first to be equipped with wireless.
,, ,, ...	s.s. *Hesperian* ..	,,	
,, ,, ...	s.s. *Pomeranian* ..	,,	
The Leyland Line	s.s. *Oxonian* ..	,,	These vessels carry a limited number of passengers, but their transport trade between Liverpool and Boston is very considerable.
,, ,, ...	s.s. *Winefredian* ..	,,	
The White Star Line	s.s. *Cymric*	,,	Passenger vessel between Southampton and New York.
,, ,, ...	s.s. *Merion*	,,	For service between America, Australia, and New Zealand.
,, ,, ...	s.s. *Canada*	,,	
Bucknall S.S. Lines, Ltd. ..	s.s. *Kioto*	¼ kw. and emergency set	Cargo vessel with world-wide service.
The Petroleum Carriers, Ltd. .	s.s. *C. A. Canfield* ..	,,	Oil steamer.

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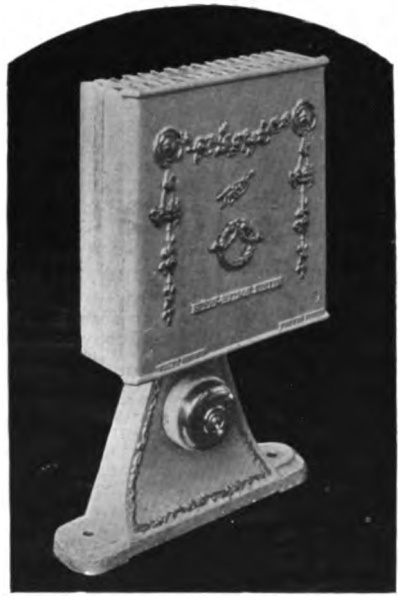

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Orders have been received during the past month to equip the following vessels with Marconi Apparatus.

Owners.	Name of Vessel.	Installation.	Remarks.
J. H. Welsford & Co.	s.s. *Indore*	1½ kw. and emergency set	—
Union Castle Line	s.s. *Llanstephan Castle*	,,	Carrying Royal mail and making intermediate services between London and South and East Africa.
.. ..	s.s. *Llandovery Castle*	,,	
Greenshields, Cowie & Co. ..	s.s. *Knight Companion*	,,	—
.. ..	s.s. *Knight Templar*	,,	—
.. ..	s.s. *Knight of the Thistle*	,,	—
British India S.N. Co. ..	s.s. *Mashobra* ..	,,	Passenger vessels between Calcutta, Rangoon, and United States.
.. ..	s.s. *Merkara* ..	,,	
Cunard Steamship Co. ..	s.s. *Andania* ..	,,	Passenger vessels sailing between Southampton and Montreal.
.. ..	s.s. *Alaunia* ..	,,	
J. Chadwick & Sons	s.s. *Drumcliffe* ..	,,	Cargo vessel between Liverpool and Buenos Ayres.
The Royal Mail Steam Packet Co.	s.s. *Caribbean*	,,	Engaged on regular service to South America.
Harvey & Co.	s.s. *Bonaventure* ..	,,	Cruising in Newfoundland. Hitherto engaged in seal fisheries.
.. ..	s.s. *Bellaventure* ..	,,	
Trinidad Shipping and Training Co.	s.s. *Matura* ..	,,	Travelling between New York and Trinidad with fruit cargo.
The Atlantic Transport Co. ..	s.s. *Manhattan* ..	,,	Passenger vessel between Antwerp and Boston, sailing under the direction of the Red Star Line.
The Tyne and Tees Shipping Co.	s.s. *New Londoner* ..	½ kw. and emergency set	Cargo vessel carrying limited number of passengers between London and Newcastle, making twenty-six hours' run.

The names of vessels appearing in the table below were held over from last month's record of contracts owing to lack of space.

Owners.	Name of Vessel.	Installation.	Remarks.
The Royal Mail Steam Packet Co.	s.s. *Magdalena* ..	1½ k.w. and emergency set	North Atlantic.
The Atlantic Transport Line	s.s. *Mesaba*	,,	—
The Brazilian Government	s.s. *Carioca*	½ kw. and emergency set	South African and genera trade.
The Bucknall Steamship Co.	s.s. *Kansas*	,,	—
		,,	—
.. ..	s.s. *Kafue*	,,	—
.. ..	s.s. *Karonga*	,,	India.
The Hall Line	s.s. *Sandon Hall* ..	,,	India.
.. ..	s.s. *Walton Hall* ..	,,	—
The City Line	s.s. *City of Lincoln* ..	,,	Calcutta and West Indies.
James Nourse & Co.	s.s. *Dewa*	,,	Mexico.
The Petroleum Carriers, Ltd.	s.s. *Norman Bridge* ..	,,	Honolulu and general.
Watts, Watts & Co.	s.s. *Ascot*	,,	—
The Anglo-American Oil Co.	s.s. *Lackawanna* ..	,,	North Atlantic.
The Viking Cruising Co.	s.y. *Atrato*	5 kw. and emergency set	—

Patent Record.

The following patents have been applied for since we closed for Press with the May number of this magazine :

No. 8,821. April 15th. Ges. fur Draht. Telegraphie, M.B.H. Receiving arrangement for use in wireless telegraphy and telephony.

No. 10,153. April 30th. Fabio Majorana. Wireless telephone.

No. 10,160. April 30th. Michael Corlon. Caller for wireless telegraphy.

No. 11,106. May 10th. Marconi's Wireless Telegraph Co., Ltd., and Cyril P. Ryan. Wireless telegraphy.

No. 11,371. May 15th. Guglielmo Marconi. Wireless telegraph transmitters.

No. 11,453. May 16th. Marconi's Wireless Telegraph Co., Ltd., and C. S. Franklin. Means for detecting continuous electrical oscillations.

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Marconi Athletic Club

Weather permitting, there should be a record season for the Athletic Club. The ground at Acton is in good condition, and many improvements have been carried out. The tennis section now possesses three double courts and one single court, and these have been so arranged as to make the conditions of play practically perfect. Besides this a sub-committee has been organised to arrange for refreshments, and members will now be able to obtain excellent teas, or what else they may require, at reasonable prices on the ground. Cricket opened on Saturday, May 17th, with a match between the Marconi first XI and Coningsby Cricket Club at Neasdon. The visitors lost by 5 runs, the total scores being Marconis 49, Coningsby 54. On the same day the Marconi second XI were at home to Coningsby's second XI, and the scores were again with our opponents at 36 to 55. The swimming section is in full swing. Six new members are receiving instruction, and a large number are practising strenuously. On May 8th a one-length relay race was lost to the Bank of Montreal by 10 yards, and again, on May 20th, the Royal Mail Steam Packet Company won the honours after a strenuous struggle by a yard. Several more matches have been arranged, and as an incentive to the members, a prominent director of the Marconi Company has promised to present a cup for competition.

Friday, May 16th, was the anniversary of the establishment of Marconi's Wireless Telegraph Company in Marconi House, and the event was duly celebrated by a smoking concert given that evening in the school under the auspices of the Athletic Club. This is to be the first of a series of such concerts, and if the one held on the sixteenth is earnest of the future, they should prove bright particular events in the social life of Marconi House. Captain H. R. Sankey was in the Chair, and the artists were all drawn from the Marconi *personnel*. The programme was varied, well rendered, and heartily received, and the evening's entertainment was unanimously voted a complete success.

The Marconi Philatelic Society

On Friday, May 2nd, the inaugural meeting of the Marconi Philatelic Society was held, when Mr. Allen occupied the chair. The chairman, in opening the proceedings, explained that the club's *raison d'être* was the promotion of informal and friendly discussion among the stamp collectors of Marconi House, and he believed that such a society would provide excellent opportunities for the interchange both of ideas and specimens.

It was unanimously agreed that Mr. Everett should be secretary; while the proposal was adopted that the members should pay an annual subscription of 1s. a year, the amount so subscribed to form a fund for the purchase of all the more important Philatelic journals, and the most up-to-date catalogues.

It was further decided that corresponding members should be invited to join the society, and it is hoped that many of the Marconi engineer operators in all parts of the world will be able to avail themselves of this invitation. The secretary will be pleased to hear from any such intending members, and should they wish to exchange stamps with other members of the society, he is prepared to look after their interests in this respect. Lastly, any others of the staff who are interested in philately, whether as amateurs or experienced hands, will be welcome in the club. Meetings will be arranged for the third Friday of each month during the summer, and every first and third Friday during the winter.

Movements of Engineers

B. S. Benning has returned from Chili.

Messrs. Blackett, Dickson, and Oliver have been transferred from the London drawing office to Chelmsford works.

Lieut. M. Escolano has been transferred from the London drawing office to Valentia Island, S.W. Ireland, to assist Mr. D. H. Jones in the erection of a wireless telegraph station for the General Post Office.

R. J. Gilmour is now ship fitting in the Liverpool district.

C. James is fitting the Chilian transport *Rancagna* in Liverpool.

E. C. Montague is now stationed at Poldhu.

A. T. Pole is now assisting on ship fitting.

W. O. Ridley is now assisting in the drawing and design section at the London office.

H. J. Round has returned to London from Glace Bay.

H. E. Shaw is now at Poldhu station.

C. H. Taylor is temporarily in London from New York.

Movements of Operators

J. G. Wasley, *Campania* to *Campanello*.
L. Breen, London School to *Campanello*.
G. Madgwick, *Minnetonka* to *Isis*.
G. Thomson, *Sicilian* to *Sardinia*.
A. E. Hanson, *Hesperian* to *Corsican*.
A. Perlman, Liverpool School to *Empress of Britain*.
F. Milford, *Campania* to *Oropesa*.
J. Williams, Liverpool School to *Devonian*.
H. Mole, *Corsican* to *Baltic*.
H. T. Stubbs, *Worcestershire* to *Devonian*.
C. Robertson, *Galician* to *Mamari*.
J. E. Davies, *Canadian* to *La Blanca*.
F. Mitchell, *Canadian* to *Hypatia*.
T. G. Petersen, *Moldavia* to *Clifden*.
H. Hunt, *Arawa* to *Arabia*.
A. Kingsbury, *Moravian* to *Makarini*.
A. M. Entwistle, *Grantala* to *Oceanic*.
R. M. Owen, London School to *Oceanic*.
L. S. Newns, *Mechanician* to *Manco*.
H. T. Little, *Highland Warrior* to *Highland Loch*.
A. G. Angill, *Cymric* to *Canada*.
J. H. D. Lees, London School to *Oruba*.
W. Pitkeathly, *Tagus* to *Star Point*.
B. F. Aris, *Magdalena* to *Waipara*.
S. K. Alston, *Asturias* to *Itassuce*.
F. Arnott, *Ivernia* to *Saldanha*.
C. J. A. Gill, London School to *Corinthian*.
H. Cottam, *Minnetonka* to *Minnewaska*.
S. C. Summerlin, *Michigan* to *Star of Scotland*.
C. P. Litchfield, London School to *Minnehaha*.
N. Holker, *Antillian* to *Desna*.
W. J. Leche, Liverpool School to *Afric*.
J. G. Chadwick, Liverpool School to *Eagle Point*.
A. C. Lund, *Mauretania* to *Virginian*.
H. W. Rice, *Cestrian* to *Empress of Ireland*.
W. R. Bain, *Cestrian* to *Kelvingbank*.
E. Shayler, *Desna* to *Carmarthenshire*.
A. J. Gash, Liverpool School to *Michigan*.
D. O'Sullivan, *Adriatic* to *Rappahannock*.
R. M. Geldart, London School to *Minnewaska*.
R. Emanuel, London School to *Canadian*.
W. J. Donnan, London School to *Celtic*.
J. R. Bamford, *Guarany* to *Himalaya*.
W. Condon, *Montfort* to *Sicilian*.
J. Beckett, London School to *Amazon*.
C. V. Maudsley, *Karina* to *Mauretania*.
L. T. Barker, London School to *Parisian*.
H. R. Hoare, *Perugia* to *Hesperian*.
E. L. Rumbold, *Amazon* to *Moldavia*.
H. A. Whittaker, London School to *Arlanza*.
J. Lucey, *Grampian* to *Campania*.
W. H. Haywood, *Omrah* to Teneriffe Land Station.
J. Leverett, *Corinthic* to *Magdalena*.
R. Sweetnam, *Minnewaska* to *Highland Piper*.
A. W. Wyett, *Marmora* to *Orvieto*.
A. C. Williams, *Sardinia* to *Inkosi*.
J. Breen, *Sunda* to *Beacon Grange*.
T. L. Empson, London School to *Magdalena*.
O. P. Keane, London School to *Majestic*.
F. J. Smith, London School to *Cassandra*.
G. G. Chapman, *Highland Scot* to *Persia*.
A. G. Angill, *Bocic* to *Cymric*.
T. H. Halsall, *Cassandra* to *Mongolian*.
A. E. R. Ballard, *Columbia* to *Mongolian*.

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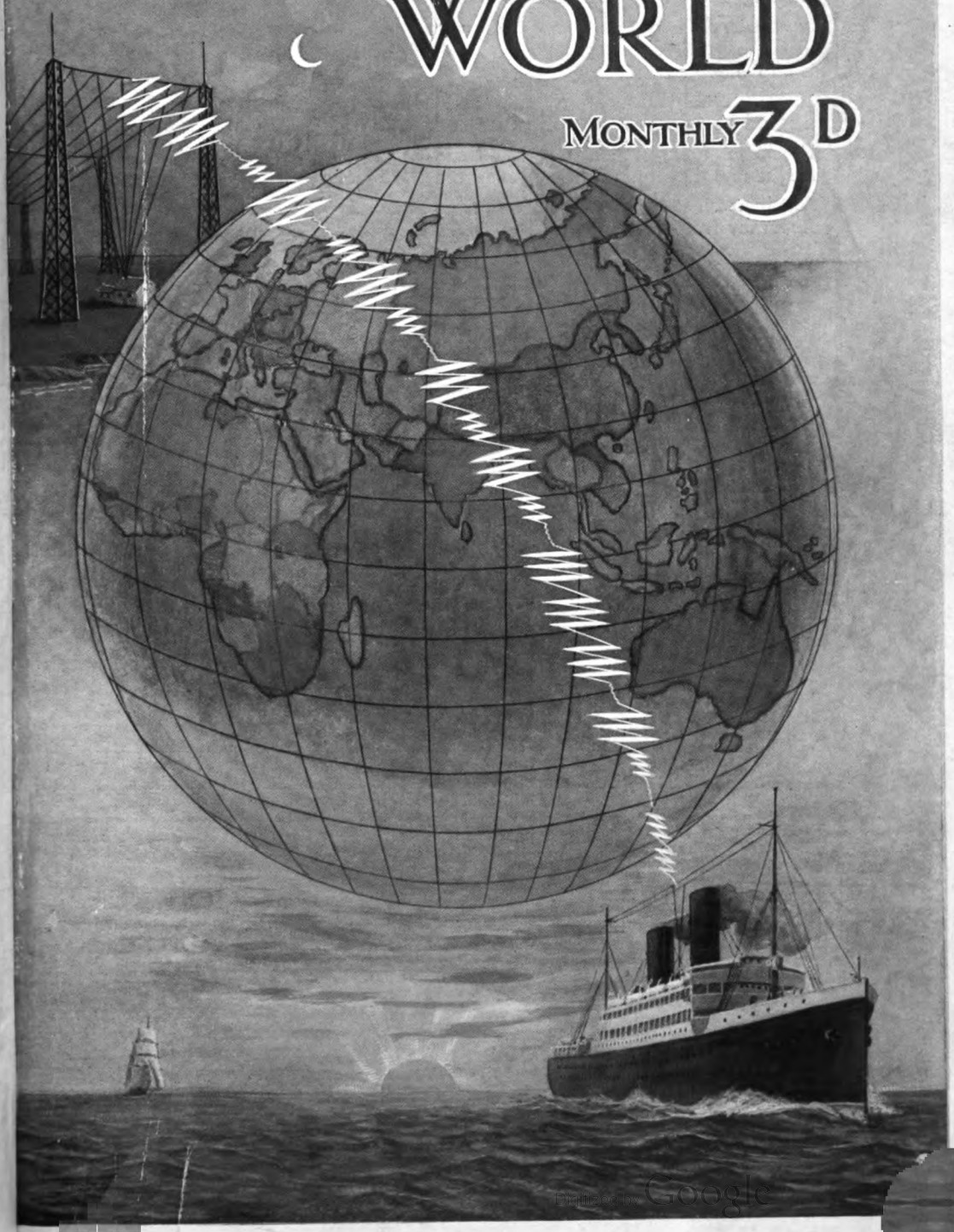

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The Wireless Year Book

IT is with unfeigned pleasure that we have to acknowledge the cordial welcome extended to "The Year Book of Wireless Telegraphy and Telephony 1913," which made its appearance in May last. Before offering the book to the public we were assured that the subject it dealt with had reached a sufficiently advanced stage to justify the publication of an annual record. The only doubt that lurked in our minds concerned the practicability of the task we had planned. Any such doubt, however, has been entirely dispelled by the reception accorded to the Year Book, not only by the Press—technical and lay—but also by the public.

We have every reason to be satisfied with the Year Book, for within one month of publication about three-quarters of an edition of ten thousand copies was disposed of. More than that, however, we have received many congratulatory letters from purchasers, which encourage us in the belief that the book will go far to satisfy a demand which undoubtedly exists.

The excerpts from the Press comments, which we give below, indicate the general tone of the reception accorded to the Year Book by the Press. Thus the *Financial Times* says of it:

> "As it is available to the public for the comparatively modest sum of half-a-crown, it justifies itself as a popular reference work in a way which many far higher-priced and not better-edited annuals certainly do not."

In the opinion of a reviewer in the Engineering Supplement of *The Times*, the volume "covers a wide field, and it contains much information of value to those interested in the subject." The *Electrician* considers that for the purpose for which it is published "the Year Book is excellent value," and although our contemporary complains that it is burdened by *embarras de richesse*, we do not think they will find many to share the complaint with them. We have aimed to provide—and the *Scotsman* credits us with having achieved—

> "An interesting and well-ordered conspectus of information of a general and statistical kind, accompanied by many special articles by expert writers."

We do not pretend to have attained perfection, and in spite of the pains taken to ensure accuracy we have since noted one or two errors which we would like to rectify.

One is the omission from the list of periodicals, given on page 545 of the Year Book, of the name of *Electrical Industries*, due entirely to a regrettable oversight, for which we tender our apologies to our contemporary.

In the Glossary of Terms (root means square value), on page 431 the words "The square root of the sum of the squares" should be read "The square root of the mean of the sum of the squares."

Section 20 of useful formulæ on page 411, in the formula for the inductance of a solenoid single layer, the negative sign in the root denominator should be the positive. In the same section in the last column, for "r is mean radius," read "a is mean radius."

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MR. P. BALINSKI.

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The Wireless World.

With which is incorporated "The Marconigraph."

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All Editorial communications to be addressed to "The Editor, 'The Wireless World,' Marconi House, Strand, London, W.C."

The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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Personalities in the Wireless World

MR. PETER BALINSKI

Vice-President of the Board of Directors of the Russian Company of Wireless Telegraphs and Telephones, St. Petersburg.

MR. PETER BALINSKI was born at St. Petersburg in 1865. His father, Professor Ivan Balinski, was a notable figure in the ranks of Russian men of science, for besides being a specialist in mental diseases, he was Russia's first eminent physiologist.

Mr. Peter Balinski was educated in one of the public schools of St. Petersburg, and afterwards studied pure mathematics for three years at the St. Petersburg University. Later he became a student of the Emperor Nicolas I. Institute of Civil Engineers, where he took a honours degree as a civil service engineer. Just about this time the Russian Government undertook the construction of the Vilno-Rovno Railway for strategical purposes. The young engineer was immediately employed on this undertaking, and continued to occupy his post until the entire work was completed, when he set up as an architect in his native town. For many years he was attached in this capacity to the St. Petersburg municipality, and several official institutions, hospitals, colleges and many private houses were erected to his designs.

But new ideas and original schemes have always had an attraction for Mr. Balinski, and the rapid development of Russia's larger cities suggested the increasing need for improvement in the means of passenger transit between the various districts of such cities. For seven years Mr. Balinski devoted himself to the study of this problem; and frequent voyages abroad gave him the opportunity of studying the organisation of similar services in the cities of Europe; he gathered abundant statistical data, and elaborated a vast scheme for a Metropolitan Railway system in St. Petersburg.

Three times Mr. Balinski made application to the Government for permission to construct this railway. Each time his scheme received the approval of Russian official circles, and twice it was considered by the Privy Council and discussed by special committees which were appointed by the Government.

Twice also Mr. Balinski succeeded in obtaining the collaboration of foreign capitalists—English and American willing to invest money in the enterprise—but the Government, though giving its general approval to the project, was disinclined to undertake the responsibility of giving a formal guarantee to the undertaking, a condition which the prospective capitalists made a *sine quâ non*, nor would the Minister of Finance grant the right of a free import into Russia of the machinery and metal wares necessary for the construction of the proposed railroad.

In the face of such difficulties it would have been madness to have proceeded farther with such a vast scheme, and Mr. Balinski wisely decided to let the matter drop, at least for a while, and to turn his attention to new lines of industrial activity. He quickly found that the time and trouble he had devoted to this public-spirited project had not been entirely wasted. His negotiations had brought him into touch with a number of important personages and firms in the industrial world. These were quick to appreciate his marvellous capacity for affairs, and many important English and Continental business houses asked him to represent them in Russia. But Mr. Balinski was anxious to associate himself with a scheme that would combine a national benefit with personal interest, and his choice fell on wireless telegraphy. At that time a project was already on foot to establish a wireless company in Russia, and he immediately identified himself with the movement, so that when in 1908 the Russian Company of Wireless Telegraphs and Telephones was inaugurated he was nominated Vice-President, and through its subsequent career he has been one of the most active members on the Board.

B

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EPISODES OF THE MONTH

THE REPORT OF THE DEPARTMENTAL COMMITTEE OF THE BOARD OF TRADE ON BOATS AND DAVITS. MR. MARCONI'S EVIDENCE BEFORE THE SELECT COMMITTEE. A NOTABLE FEAT IN WIRELESS TELEGRAPHY. A NOVEL INNOVATION. THE SHARE MARKET.

THE Departmental Committee of the Board of Trade on Boats and Davits has now made its report, which was presented to Parliament on June 18th. The main recommendations are concerned with the design and manipulation of ships' lifeboats, and the report is instructive where it deals with some of the suggestions for rafts, pontoons, lifeboats and methods of launching them, which were so freely advocated about a year ago. The section dealing with the life-saving equipment of ships is one which particularly interests us, as it refers chiefly to the application of wireless telegraphy to ships' lifeboats. The Committee refer to a "very carefully considered scheme for equipping a certain number of ships' boats with short range installations, put before them by the Marconi International Marine Communication Co., Ltd.," but they "do not feel in all the circumstances that there is any necessity to require any of a ship's lifeboats to be fitted with a wireless telegraph apparatus." The Committee have doubtless chosen this form of exception lest any other view might give rise to a premature demand for the compulsory equipment of such boats. Their reticence is perhaps justified by the fact that no one at the present moment has any experience of the working of wireless telegraphy on lifeboats in the open sea after a shipwreck. Further, there are obviously many points to be considered before such a project can be efficiently carried out, and the idea is evidently one which must be developed by the shipowners and the Marconi Company working together in the closest co-operation. This point will better be appreciated by a perusal of the evidence presented to the Committee by the Marconi Company when this evidence is available.

To return, however, to the Committee's report, it is not clear to us what is meant by the following extract from page 26 of the report: "The only advantage to be obtained from the fitting of a ship's boats with appliances of this kind is that they may assist a relieving vessel in picking up the boats. The ordinary wireless telegraphy installation would be of little value for this purpose." If by the "ordinary wireless telegraphy installation" is meant the standard plant fitted on ships, it is obvious that it could not be installed on a lifeboat, as it is designed for entirely different purposes and conditions. The evidence of the Marconi Company was given as far back as January 16th, and it is perhaps unfortunate that the final form of the apparatus which the company proposed to use for lifeboats could not be executed in time to place before the Committee for their inspection. Since that time, however, considerable progress has been made, and the company will shortly be in a position to demonstrate the practicability of wireless telegraphy as applied to ships' lifeboats.

* * *

We are pleased to note that the summary of Mr. Marconi's evidence before the Select Committee, which we published last month, has aroused considerable interest. Several correspondents have been unable to reconcile a statement made by Mr. Marconi with an announcement which appeared in the Press a few days later, and they have appealed to us for an explanation. In his evidence Mr. Marconi said: "I understand that Mr. Gandil, acting on his" (Dr. Poulsen's) "advice, now proposes to use 150 or 200 kw. for a distance of 2,000 miles, and I agree with him that he will require all this power or more if he be able to construct an arc of such a power, and, when constructed, if he

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can discover the means of effectively utilising that power."

Further, in paragraph 19 of this report the Advisory Committee state: "We conclude that if the Poulsen system is to be so developed as to be practicable for commercial purposes over distances of 2,000 miles or upwards, the arc will have to be constructed so as to supply the aerial with higher power, or else a more sensitive receiver will have to be used." Reading these pronouncements, our correspondents are at a loss to understand how the contract which the United States navy is said to have made with the Federal Wireless Telegraph Company (Poulsen system) for the supply and erection of a 100-kw. 3,000-mile station will be fulfilled. We would refer them, however, to the examination of the Poulsen "system" which appears on page 228 of this number. Meanwhile we can only add that when a satisfactory 100-kw. arc makes its appearance we shall have to modify our views.

* * *

A noteworthy feat has just been carried out at Cape Race, on the Newfoundland coast. As we announced last month, the wireless telegraph station was put out of action through fire, but at the time of writing we did not anticipate that the interference with the regular operation of the service would be of such short duration as actually happened. Immediately after the fire, work was commenced on the erection of a temporary station, and on permission being obtained from the Department of the Marine and Fisheries of the Canadian Government, the Cape Race Lighthouse engine was belted to the wireless transmitting apparatus, and the temporary installation put in running order. It is gratifying to note that within three days of the date of the fire a continuous twenty-four hour service was again established, and the station was able to effect communication with all vessels on the Canadian route. Cape Race, which is sometimes referred to as "the graveyard of the Atlantic," has become renowned by reason of the services which the station has rendered as an aid to navigation and in cases of shipwreck. It was erected by the Marconi Company, and is controlled by them on behalf of the Canadian Government. It is of great strategic importance, and the new station building to be erected will be of a special fireproof construction. The apparatus will be of a powerful type, so that communication can be maintained with vessels half-way across the Atlantic. Cape Race will very soon have a wireless equipment, therefore, such as it calls for by the importance of its position, commanding as it does the whole of the Grand Banks of Newfoundland, the most dangerous portion of the Atlantic Ocean.

* * *

"A Forum for Electrical Inventions," is the novel innovation proposed by the New York Electrical Society, and one to be welcomed in these days, when the principal function of so many societies seems rather to be the discussion of abstruce technical papers than the rendering of practical assistance to their members. The object of the Forum will be to assist members in keeping abreast with the very latest electrical developments. Manufacturers and inventors having electrical inventions, devices, and appliances of merit will be invited to exhibit them before members at the regular meetings of the society, and to explain them after the usual business of the meetings. It is hoped that in this way the newest apparatus will be brought to the attention of electrical engineers month by month. While it is increasingly difficult to cover a large and prolific field of invention, the Forum, as it aims to do, should certainly enable members to become better posted on current developments, not only in their own branch, but in others outside, in which they naturally have an intelligent interest.

The Share Market

London, *June 20th*, 1913.

The depression has been very pronounced in the share markets since our last issue, caused by general monetary and political consideration. Although a considerable business has been transacted, the great majority of transactions have been in the nature of realisations of a more or less forced character, the relapse in values in many cases having been severe. The Marconi issues have only suffered moderately in comparison with the declines that have taken place elsewhere. The closing prices as we go to Press are: Ordinary, $3\frac{3}{8}$; Preference, $2\frac{3}{4}$; Canadian, 10s. 6d.; Spanish, $\frac{11}{16}$; American, $\frac{13}{16}$.

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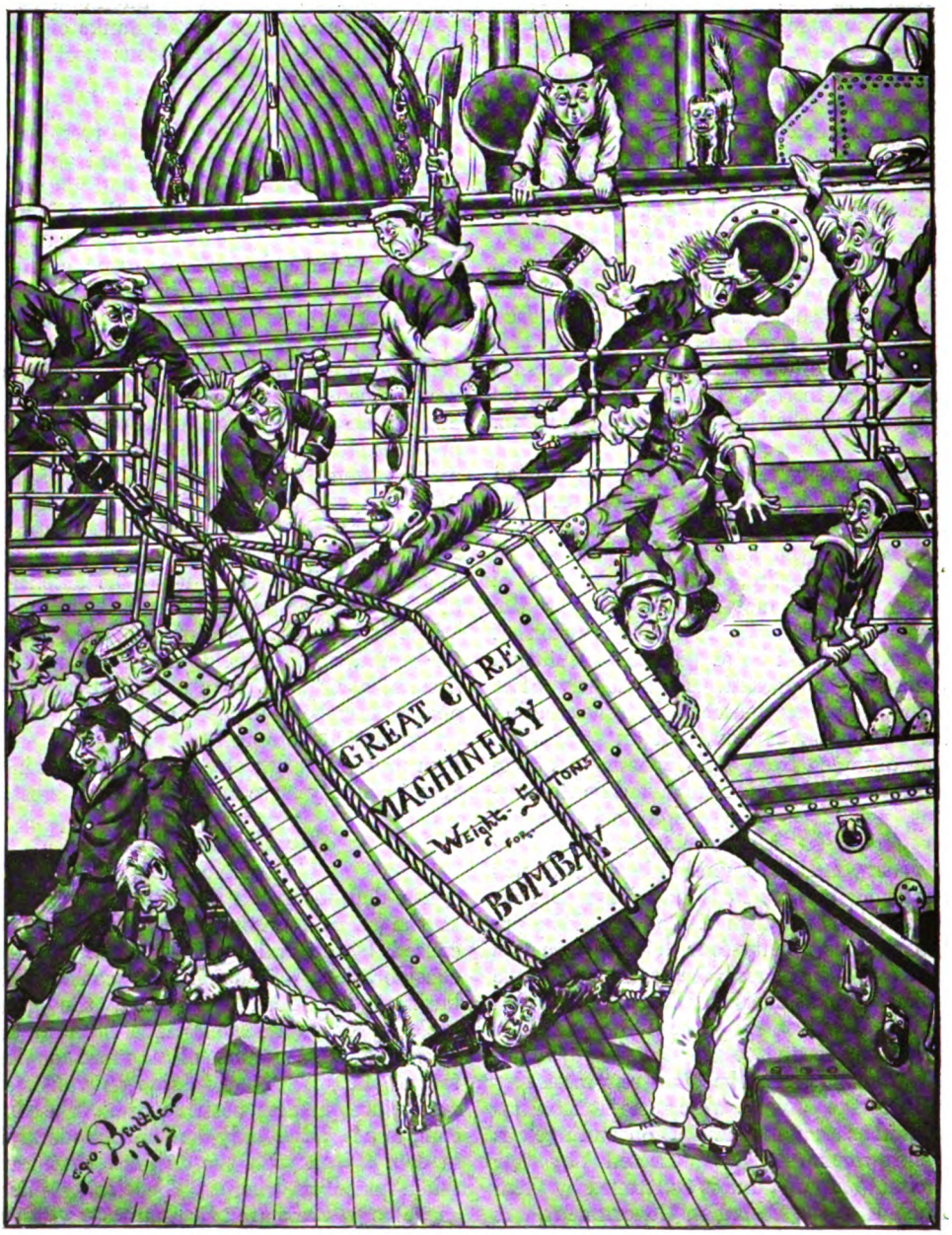
CARTOON OF THE MONTH

Wireless Terms Illustrated



IV.—Jamming

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Across Bolivia with a Portable Set

By RENÉ DEMONT, Ing. Dip.

WHO has not, when looking at a map of the world, had his gaze drawn to that expanse of territory perched like the eyrie of an eagle at the head of the great chain of the Andes ? That vast territory to which Bolivar gave his name looks like a mighty Switzerland, cut off from the sea, almost helpless to communicate with the outside world, and seemingly condemned to perpetual poverty. But what a different picture it presents to those who have had the good fortune to visit its fastnesses ! It is a land of the giantesque. The least of its lofty mountains has an altitude of over 8,000 feet, but many of these giants of time have suffered from the insatiable energy of man. Often they have been torn open in a fruitless quest for mineral ore. But besides mountains there are the great rolling plains with grass so tall that a mounted man can easily be concealed in its green depths. Further, there are wide tracts of forests of rare trees where the undergrowth forms a network so dense that it is practically impassable.

The people of Bolivia are of very mixed nationalities, and this is due in a large measure to the influx of Spanish blood during the sixteenth century. They can in a general way be divided up into three classes : there are the Bolivians of European ancestry, the Indians proper, and the *mestizos* or *cholos*, which are of mixed European and Indian origin. These last are the most interesting to foreign travellers by reason of the contrast in temperament, appearance and manner of life to the white men, who, though less numerous, control affairs and fill all the positions of authority, whether political or commercial. But it is particularly noticeable that the white man seems to thoroughly understand his primitive *protégé*, and the Indians as a whole receive at the hands of the governing race as much consideration as the ignorant poor of any land receive from those who by inherited or acquired power hold the reins of authority. The laws of Bolivia provide for the Indians in a liberal manner, and under the influence of civilisation these

The two Pack Saddle Stations employed during the Manœuvres of 1911.

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long-neglected people are surely but slowly advancing in material and intellectual well-being. The members of most of the Indian tribes (and their divisions and sub-divisions are extremely complex) are excellent craftsmen, well skilled in the making of utensils, and still more in their ornamentation ; while the Indians of Potosi are particularly expert in miniature work. Among other curious handicrafts they make dolls, which are no larger than mosquitoes, yet if examined under a magnifying glass they will be found to be perfectly made, and dressed correctly in every detail.

The whole land is a country of dreams and of fairies, from La Paz, lying on the side of a lake twenty times as big as the biggest lake in Europe and 5,000 feet above sea level, right to the smiling and sunny confines of Riberalta or Santa Cruz, where the gum trees stand like armies in their thousands; from the high wastes where the Royal Condor sits in solitude to the green plains where the streamlets are the arms of the sea, it is one vast realm of fancy.

H.E. General Ismael Montes, President of Bolivia.

But it is this wealth of vegetation, rich and holding untold riches, that is the real barrier to the development of nearly the whole of Bolivian territory. It cuts the country into two and makes communication between the north and the south well-nigh impossible. Travellers from La Paz to Riberalta must take to the river courses, and a two months' trip downstream means one of four or five months on the return, for our term "river" is ridiculously applied to pouring waters which ought more fitly to be called torrents, and even then their great waves and vast expanse make such a description inadequate and unsuitable. Imagine a river like the Thames leaping from cascades into rapids, from rapids into cascades, and you will have a pretty clear idea of one of these "streams."

But you will not appreciate the sensation of a trip on this torrent made in "boats" fashioned from creepers pressed one against the other to form two huge bundles, which are joined by a little flooring of frail planks and make a primitive sort of raft. Put this little craft on the torrent and see it leap the sixty-mile-an-hour rapids, and you may well pray to be in the good graces of the helmsman. It goes hard with those who miss the rapid or strike a rock; the crocodiles alone can tell *their* story.

Such a hazardous and necessarily slow means of communication makes intercourse between the north and the south extremely rare, while the impossibility of the laying a single telegraph line in these virgin forests is a foregone conclusion to all who know the country. Nevertheless, it is equally clear that the adoption of some means for linking up these two areas of Bolivia was a matter of the utmost urgency for the Government.

As the most satisfactory solution to this

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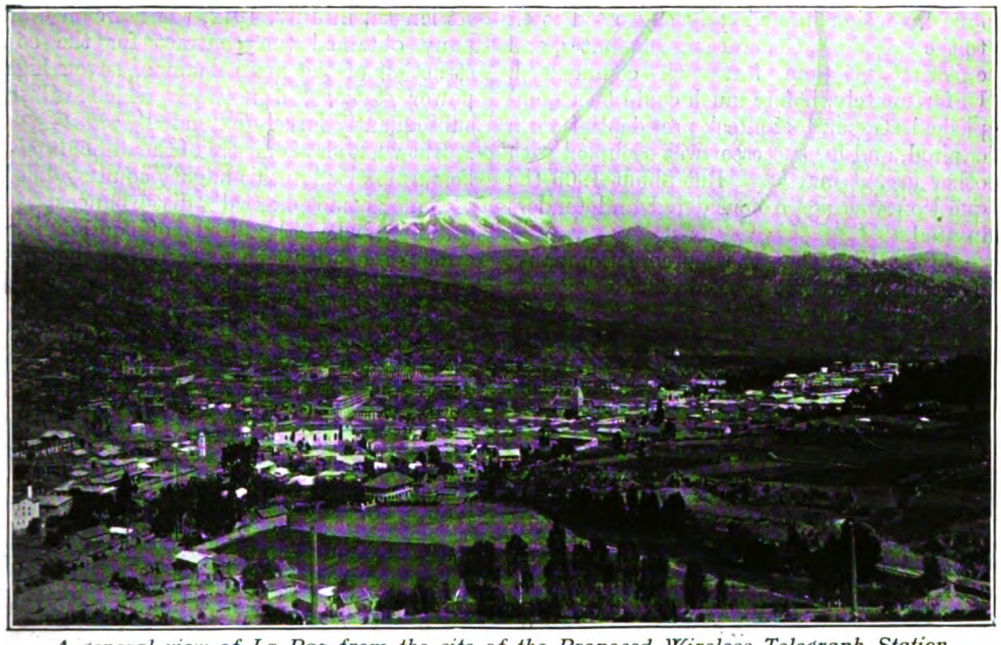

A general view of La Paz from the site of the Proposed Wireless Telegraph Station.
Mount Illimani, 24,000 ft. high, in the background.

Celebrating the Anniversary of the Liberation of Bolivia in La Paz.

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problem the utilisation of Marconi's marvellous invention immediately suggested itself to the President, General Ismael Montes, and experiments were forthwith commenced. Unfortunately, before much could be accomplished, General Montes' presidential term expired, and his successor was occupied with other urgent matters. But about 1909 the question was again considered and tenders invited.

It was then that the Marconi Company, unwilling to plunge into a venture without a full preliminary knowledge of the difficulties to be overcome, decided, before submitting a proposal to the Bolivian Government, to send out two portable installations, whose test performances would furnish information of material value in the construction of a general wireless network.

The tests were followed very closely by the Bolivian Government, the more so since there was a strong body of opinion in favour of a Bolivian chain. They lasted nearly two years before the Government finally decided upon the adoption of a system. At length, in July, 1912, the Marconi Company obtained the contract for the construction of the main chain of seven high-power stations, a network which will be subsequently largely extended.

But what shall one say of the difficulties to be surmounted in this mighty country where violent atmospherical disturbances are common, where hundreds of square miles are covered with trees, where right between two stations stands a little mountain which seems to present no impediment, but all the same hinders all attempts at communication owing to its highly metallic nature ?

Yet all these difficulties were well known to the Marconi Company, which had already met and conquered them between Manaos and Porto Velho, so the chain so wisely provided will give every satisfaction to the Bolivian Government.

To recount the many experiences with the two portable stations would occupy an entire volume, so I shall content myself with recalling those during the military

The Alemeda, the favourite Promenade of La Paz.

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Tembetas, Indians of Santa Cruz.

manœuvres of 1911, manœuvres that were important because they brought together almost the whole of the Bolivian army.

Leaving La Paz, we set out. There is trouble ahead of us. For the first time in their lives the mules are saddled with European pack-saddles with all their impeding leathers. They start by rolling on the ground, and then, finding it unwise to kick against the pricks, they accept their lot and away we go.

After three hours' climbing on a ten per cent. gradient from the hollow in which lies La Paz, we reach the summit, 13,000 feet above the city, where the wind blows hurricanes. The thirty miles of the first stage of the journey are covered in seven hours; the little Bolivian soldiers, scarcely five feet high, swing along joyously, each carrying, in addition to his equipment, a tent and food for about ten days' manœuvres, for one must not reckon on a well-ordered commissariat in this great country where villages exist only every fifty miles or so.

We halt at last, a little tired by this first journey. But we are happy and await impatiently the first experiments, just a little apprehensive of what this sandy and stony waste holds for us.

The second day sees us thirty-eight miles along the white road, gloomy and dejected, relieved only by the endless chatter of the soldiers who ask countless questions about a new piece of apparatus they are escorting. They are quiet, intelligent fellows, certainly little in touch with this new development, yet so eager to be instructed that it would show a churlish disposition to be angry with them. Reaching headquarters a little behind time, we find that the second wireless station has arrived by rail. Here we join forces. My little company have stood the journey well. They are dusty, but fresh and ready for the manœuvres the next day.

Wireless station "A" is with the State Major-General; station "B" follows the Blue army. At 5 a.m. we are up for the first experiments over a mile and both stations are erected. Station B accompanies the Blues, but, to my intense dismay, no message comes through. Mounting a horse, I gallop to station "A" in order to find out the reason for its failure to communicate, and to my surprise I discover that the

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A Bridal Couple of the Country District, near Potosi.

Guarayo Indians.

soldiers have forgotten to couple the dynamo to the mast. This is soon remedied; "A" gets into touch with us, and all goes well. An order comes to take down "B" and follow the Blue army. I gallop back to "B" station.

I am held up by an amiable "joker," who remarks that my way of sending messages is very effective, but not very original. That is because he has seen me galloping from one to the other and hasn't a shadow of doubt but that it was I who had carried the telegrams! We shall see to-morrow.

In the evening we arrive at Chijta, 17 miles from Patacamaya, the headquarters of the State-Major. The bugle sounds for supper, and we have the first bite since morning. The mast is erected to receive orders.

Nineteen minutes later communication is established. The night is splendid, the signals are very clear, and the orders are sent perfectly. My critic of the morning I remember with heartburnings; would that he were here so that he might be convinced that the Marconigrams had not travelled by courier this time!

On the following day we travel another 25 miles. At night communication is established. The battle starts and orders are received right to time. Again the mast comes down and we get on the move. Fifteen miles farther on we set up the mast again; all goes well.

"What! fresh orders?" "Yes. You are supposed to have no more ammunition. Retire to cantonments at Sicasica." Another 15 miles back. Down comes the mast again, and away we go. But what a journey! It is midnight. A lashing rain, and world black as the Pit. We have to put up the mast again. It is quite evident we cannot communicate 42 miles in the tempest, and how are we going to set up the station in the dark and in the middle of a town?

We find a street a little farther on and set up the mast by a sort of instinct. When all is ready along comes a courier at a gallop, collides with the stays, and down comes the mast.

At last we are ready again. The spark is clear. Listen a moment. There! We have got into touch, and the wireless messages come, the signals being clearly distinguishable from the muttered rumbling of the

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storm. The rain is still pouring in torrents.

"Hurry this 140-word wireless message to the General, and we can get a little sleep at last." It is 2 a.m., and in what state do I sleep?—in the room of a real general! Forty minutes later I have the satisfaction of seeing a courier arrive with a telegram which has come by wire; it is a copy of the one which came by wireless. What a success—forty minutes ahead of the wire! On the morrow I make an inspection of the mast, and am amazed that we have been able to receive messages. The two wires, for almost two-thirds of their length, are laid on a roof of zinc. What harmony between the antennæ and the circuit!

And so every day for ten days, erecting and dismantling the station two or three times a day without the slightest mishap, everything going splendidly.

At last comes the hour of reward—the Review. The Marconi Wireless Corps marches past with every eye upon them, the men smart, the motors glittering, the cases polished as if they had just come from the works instead of having travelled three hundred and fifty miles on muleback through dust and mud, this way and that.

The admiration of the officers who were called up to give an account of the services which this apparatus would render in time of war was unbounded. There were congratulations from the President and two fine reports in the general orders from the General-in-Chief, a German officer, and the General-in-Chief of the Blue division, who declared that during the whole of the manœuvres the apparatus worked night and day without interruption.

It was a triumph, for it must be borne in mind that the apparatus was worked for the first time by these soldiers, that the telegraphists borrowed from the cable service were new to it, and that the "A" station was directed by an engineer who had only seen a wireless apparatus for the first time a month before.

A few words in conclusion on the personality of the man who was chiefly instrumental in bringing wireless telegraphy into Bolivia. General Ismael Montes, when only 17 years of age and a student of law at the University of La Paz, enlisted to serve his country in the war with Chile, obtaining his commission after a few months' service. He remained in the army until he was made a Captain, continuing at the same time his studies at the University. As soon as he obtained his degree he retired and commenced to practise as a lawyer, and also acted in the capacity of Professor of Law at the University of La Paz, until the Liberal Government came into power in 1899, when he was appointed Secretary for War. On two occasions he went to the Acre territory at the head of troops, and in 1904 he was elected President of the Republic for the period ending in 1908, but owing to the death of the President elect, Congress extended his term of office for another year. On his retirement he was appointed Bolivian Minister to the Court of St. James, Paris, and The Hague, and he has now left Europe for Bolivia, having again been elected President on the 4th of May, and accordingly he will assume the Presidency on the 6th of August this year.

Two Indians of the Aymará Tribe.

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The "Systems" of Wireless Telegraphy

II. THE POULSEN SYSTEM.

By HUBERT DOBELL, M.A., A.M.I.E.E.

IN this article we propose to deal with the Poulsen "System," which, like the Goldschmidt "System," claims to produce continuous electric waves.

The Poulsen generator charges up an insulated, elevated "aerial," discharges it to earth, charges it up again in the opposite direction, and again discharges it to earth. And we must consider how this cycle of processes is effected.

THE ELECTRIC ARC.

If we open a switch or in any other way break a circuit in which an electric current is flowing the actual breaking of the current requires a certain time. During this time the contact, originally a good one, becomes worse and worse, and the surface of the parts touching becomes smaller and smaller. The result is that resistance is introduced, and heat produced; for whenever a current passes through any resistance some of it is wasted in producing heat. Towards the end of the process of "breaking" the temperature becomes very great, so that the ends of the conductors begin to glow and to emit glowing metal vapour. Even when the conductors have been separated by some little distance this vapour may cross the gap and form a conducting, luminous bridge for the current. Such a bridge is called an "arc."

Such an arc can be used for purposes of illumination, but in order to obtain a continuous light carbon rods are substituted for the metal conductors, which would soon fuse and evaporate away. Even with carbon rods special mechanism has to be applied for "feeding" the rods forwards at a rate proportional to their consumption, and also for "striking the arc" (*i.e.*, bringing the two rods into contact and then separating them) when it is required to turn on the light. All this means a great deal of complication and a good deal of unreliability.

It is this arc, with its complicated "feeding" arrangements, which forms the basis of the Poulsen System. The efficiency of the arc method for the generation of continuous electric waves is remarkably low. The efficiency of the modern Marconi disc discharger is of the order of 60 per cent., while the figure given for the arc method by Dr. Poulsen himself is only 14 per cent.

In our article on the Goldschmidt System we arrived at a point somewhat similar to this; and on that occasion we paused to ask the question, "What, then, does this system offer us to compensate for all these defects?"

On behalf of that system we gave the reply: "It offers us CONTINUOUS WAVES," and it is generally supposed that the reply is the same for the Poulsen System.

In that article, however, it was shown that no very mysterious merit lies in the mere fact of continuity; that, in fact, it is a moot point whether the disadvantages do not balance the advantages, even if continuous waves could be obtained as readily, as

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efficiently, and with as much power to back them as non-continuous waves.

The Poulsen arc, although it actually produces waves which are sufficiently "continuous" to necessitate their being split up into some kind of a note for the purposes of reception, are yet sufficiently discontinuous as to be powerless to produce to the full extent that "cumulative" result on the receiver which is the sole merit of the continuous wave.

This is a statement of fundamental importance; before we deal with it more fully we will consider in greater detail the action of the Poulsen arc as a producer of electric waves.

INSTABILITY OF THE ARC.

It is a notorious fact that the electric arc lamp is unstable. It is, in point of fact, subject to two kinds of instability. The first and obvious kind is the continual but irregular burning away of the carbon, which tends to keep the actual length of the gap in a state of variation which cannot be avoided even by complicated "feeding" mechanism. Any such variation in length of gap has the effect, naturally, of altering the resistance of the gap and the amount of current flowing through it.

In the case of the Poulsen arc, however, the burning away of the carbon electrode is reduced by the fact that the arc is formed in an atmosphere of hydrogen or some hydrocarbon; but the carbon still has to be kept turning and fed forward, and the gas has to be renewed constantly.

The other, and less obvious, form of instability is due to the fact that the arc does not behave like a simple metal conductor, in which the current increases in proportion to the pressure; the arc produces at its "poles" a back-pressure which opposes the driving force, and the matter is further complicated by the fact that this back-pressure decreases with the increase of current passing. To produce electric waves a condenser and an inductance have to be placed as a shunt to the arc, and some of the current passing goes to charge up the condenser (thus leaving less current to pass through the arc); this diminution of current through the arc causes an increase in the back-pressure; and this extra back-pressure helps to charge the condenser still more. Then, after a time, the condenser can hold no more electricity, so once more the whole current flows through the arc; the increased current then decreases the back-pressure and helps the condenser to discharge through the arc. The whole arrangement, in fact, is in a state of instability; and it was found by Duddell that by a suitable adjustment of the circuit such an arc could be made to give such rapid variations in the current (and consequently such variations in the heating effects produced at the arc) that a "singing note" was produced.

If an aerial of suitable dimensions were connected to one pole of the arc, and an earth connection to the other, it is obvious that the oft-mentioned cycle—charge, discharge, and so on—would be performed.

It is clear that such an arc arrangement, producing a "singing note," would be quite impracticable from a "wireless" point of view, the frequency being far too small, and, like the commercial alternator mentioned in the previous article, it would require an aerial some hundreds of miles long.

Dr. Poulsen, however, by a combination of various devices managed to get an arc circuit which would fluctuate at a very much greater rate—in fact, at a rate suitable for "wireless."

He first placed the arc in a closed chamber filled with hydrogen or some hydrocarbon vapour, constantly renewed; he then replaced one carbon rod by a copper electrode through which a constant stream of water was passed to keep it cool; and finally, he arranged a magnetic field across the arc which was trying all the time to extinguish the arc, and in this way quickened up the process.

TUNING.

All this sounds rather complicated and not altogether convenient, and it is difficult to imagine that regularity can be obtained.

And yet, if this cannot be done, it is quite clear that the one great advantage claimed for the Poulsen waves—extreme sharpness of tuning—cannot be obtained. The great idea of sharp tuning is that it enables the receiver of one of a pair of stations to be adjusted so that a third station, sending on a slightly different wave-length, is rendered inaudible. But, obviously, if at any moment

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the frequency of the Poulsen transmitter is liable—as it actually is—to a sudden change, the signals which it is sending out will likewise become inaudible at the receiving station. This means that many words of the message are lost; the receiving operator hurriedly changes his adjustments to suit the new conditions, and while he is searching—to find out whether the new frequency is higher or lower than before—the Poulsen arc returns, perhaps, to its old conditions.

We are now in a position to deal with the statement made earlier in this article that the Poulsen waves are not continuous.

CONTINUOUS WAVES.

That this is a fact can be very easily proved by listening on an ordinary ("non-continuous wave") detector to a Poulsen station at a short distance. If the waves were truly continuous they would—as explained in our previous article—produce no sound when received on such a detector; while, as a matter of fact, the Poulsen waves can always be heard as a hissing sound. This means that the Poulsen arc, instead of sending out an uninterrupted stream of waves, all of the same strength, actually sends out waves which at frequent and irregular intervals start to die away and then revive again. If they died away altogether before reviving then they could be received at the distant station without further trouble, though only in the form of a hiss instead of the clear musical note of the Marconi waves; but the irregular variations are only strong enough to produce the hiss when the signals are very strong—as at a short distance from the transmitting station. The result is—as we have mentioned—that by the time the signals reach the station at a distance they have to be cut up into a musical note before they can be heard; and as to the objections to this proceeding no one who has read the first article of this series can have any doubts.

On the other hand, this irregular waxing and waning which produces the hiss in the case of very strong signals is quite enough to destroy the power of the Poulsen waves to attain the cumulative effect on the receiver at the distant station.

It would appear that this irregularity is not merely a mechanical defect which one might hope to remedy in time; it has nothing to do with the "feeding" of the carbon electrode, but appears to be an inherent property of the combination used by Poulsen—an electric arc in a strong magnetic field.

We ought not to leave the subject of the real nature of the Poulsen-generated waves without mentioning one other point.

When a physicist speaks of the good "cumulative" effect and the "exalted syntonisation" possible in the case of continuous waves he means by these last two words waves which are not only perfectly uniform in strength (without any decay) but are also of a particular wave-"shape" known as sinusoidal. Any departure from either of these conditions means a decrease in merit so far as the physicist is concerned.

We have already spoken of the irregularly-spaced changes in the strength of the Poulsen waves; it remains for us to mention that the waves are not sinusoidal, "although," as one of the highest authorities puts it, "under certain conditions they may be made to be nearly so."

We are not aware that these "certain conditions" have ever been shown to hold in a Poulsen arc transmitting over any considerable distance.

LONG DISTANCE WORK.

So far we have not touched on the difficulties which arise when the Poulsen System is applied to long-distance work. These form a topic all to themselves, and before dealing with them we wished to deal with the system as it presents itself under the most favourable conditions.

The most favourable conditions for the Poulsen System are undoubtedly those which obtain when it is called upon to accomplish small distances; the Technical Advisory Committee, appointed by the Postmaster-General, has actually reported that it is "satisfied that it is practicable for short distances."

It is now time to turn our attention to LONG-DISTANCE WORK such as would be entailed by a network of "Imperial" stations.

Everything we have said already about the Poulsen System applies here, and, in addition—as we have foreshadowed—other

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points arise which have been omitted until now.

In the first place, when we have to deal with a powerful station capable of transmitting two or three thousand miles the question of the cost of the fuel consumed is of paramount importance.

We have already mentioned that the efficiency of the Poulsen generator is only a quarter to a fifth of that of the Marconi generator; the cost of electric generating plant will therefore be much greater apart from increased fuel consumption; but this is not the only cause of increased fuel consumption.

To maintain the Poulsen arc at work satisfactorily it is absolutely essential to keep it in a condition of continuous activity, and the dots and dashes of the Morse Code must be made by throwing the aerial alternately in and out of tune, or by some similar method; the generator of electricity feeding the arc is therefore working at full load *all the time*, while with the Marconi method of signalling the full load is only on for about 60 per cent. of the time. It can be shown that this adds about 30 per cent. to the fuel consumption. On the whole, therefore, the fuel consumption of a Poulsen station will be six to seven times greater than that of a Marconi station.

THE ARC AND HIGH POWERS.

In the second place—and this is a more vital point still—there is the fact that the arc is even less adapted to the utilisation of high powers than the early Marconi discharger.

It was mentioned in our last article that this early "fixed" discharger could not deal effectively with more than about 70 horse-power, but that the modern Marconi disc-discharger did deal with several hundred horse-power, and that from experimental results there seemed to be no practical limit to the amount of power which could be used effectively by a suitable enlargement of this apparatus.

As regards the Poulsen arc, Mr. Marconi stated in his evidence before the Parliamentary Committee inquiry into the Imperial Wireless Scheme, "Although I have made diligent inquiry, I have failed to learn of an arc (Poulsen) which has ever yet been constructed to effectively utilise more than 40 kilowatts" (about 54 horse-power).

It appears, from the evidence of the Poulsen experts before the Technical Advisory Committee, that they consider about 200 horse-power to be necessary in order to communicate, with their system, over a distance of two thousand miles. Some radical change would, therefore, appear to be called for in their design of apparatus before they can hope for success in commercial long-distance wireless telegraphy.

We have shown in our previous article that continuous waves, when obtained, are not an unmixed blessing, and that the modern Marconi non-continuous waves have most of their advantages and some important ones in addition; in our present article we have shown that the Poulsen System does not produce truly continuous waves, but a species of wave which has the disadvantages of the continuous wave, little of its advantages, and none of the special advantages of the Marconi wave. It also appears that a new invention, comparable in importance with the invention which converted Marconi long-distance work from an experimental result to a commercial service, is necessary before the Poulsen System can hope to attain the results which have already been obtained economically by the Marconi System. Even when the suggested invention has been perfected there will remain the great increased capital cost and cost of fuel due to the remarkably low efficiency of the generator, and to the method of signalling which is inevitable with the Poulsen System.

In these two articles we have dealt with the Goldschmidt and the Poulsen Systems. The Galletti System should, however, be referred to, although the Technical Committee's report states that "they have had no evidence as to the practicability of the Galletti System even over short distances."

We quoted in our previous article a German author who described the Goldschmidt alternator as "producing a medley of alternating currents out of which only one emerges by reason of resonance." Our experience of the Galletti generator is that it produces a medley of crude oscillating currents all interfering with one another, out of which only a few crude waves emerge by reason of good luck.

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Crystals as Rectifiers and Detectors

By A. E. H. TUTTON, M.A., D.Sc., F.R.S.

USES OF CRYSTALLISED SUBSTANCES IN WIRELESS TELEGRAPHY. THE MICROPHONE AS A DETECTOR. WHEN ELECTROMAGNETIC WAVES REACH THE DETECTOR. THE ACTION OF CRYSTALS. THE LINES ON WHICH RESEARCH SHOULD FOLLOW.

WHILE the discoveries of pure science have so frequently led to epoch-making industrial and economic results—the laboratory experiments of Hertz, following up the theory of Clerk-Maxwell, for instance, having led to the wonderful and beneficent new mode of communication by wireless telegraphy—it occasionally happens that new facts of pure science are revealed during the progress of these industrial developments themselves. Such has been the case in regard to the subject of this article, for it has been reserved for wireless telegraphy to reveal a new property of crystals, that which enables them, doubtless by virtue of their perfectly organised structure, to be capable of "rectifying" or converting an alternating current into a direct one, and of acting in consequence as a sensitive detector of electric waves.

Certain crystallised substances, especially carborundum, the crystallised compound of carbon and silicon, are now currently employed, as will be well known to many readers of THE WIRELESS WORLD, in contact with either a plate or spring of metal, or another crystallised substance, as some of the most sensitive and convenient detectors and receivers of the electric waves effective in wireless telegraphy. Such a "crystal detector" replaces the older form of receiver known as a "coherer," of which the original one of Branly or the later one of Marconi may be mentioned, consisting essentially of iron or nickel filings, confined in a glass tube between two metallic plugs. The advent of a train of electromagnetic waves in the vicinity of the coherer causes the filings to cling together in such a manner that their previous high resistance to the passage of an electric current is very materially reduced; tapping the tube again disarranges the filings and restores the high resistance, practically cutting off the current, so that a tapping arrangement or "trembler" forms an essential part of the coherer form of receiver for electric waves.

The microphone of the late Professor Hughes was subsequently found to act as a detector, the best form being a carbon rod lightly pressed by a brass spring against a steel needle, the current transmitted being received by a telephone, which more or less reproduces the sound made at the spark gap of the transmitter. It proved more sensitive than a filings coherer, but is in turn superseded by the new crystal detectors, in which the carbon of the microphone is replaced by a crystal of one of the several minerals or artificially prepared crystalline substances which have been found to be effective for the purpose. The suitability of carborundum was discovered in 1906 by General Dunwoody, of the United States Army.

Carborundum, silicon carbide SiC, is manufactured on a considerable scale on account of its great hardness, which is next to that of the diamond, by the fusion together of coke and quartz or sand in the electric furnace; it is capable of replacing the diamond in rock drills and other boring tools or grinding apparatus where extreme hardness is required, and on account of its reasonable cost has been of untold value to civil, mining and other engineers. It crystallises in the ditrigonal-pyramidal class of the trigonal system of symmetry. It generally takes the

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form of hexagonal tabular crystals, parallel to the trigonal basal plane having the crystallographic indices {111}, with the edges modified by the narrow faces of a whole series of rhombohedra of different degrees of steepness. The crystals, however, are rarely single individuals, but usually masses of parallel or other more irregular growths, or twins on one or all three of the faces of the principal rhombohedron {100}. The angle of this rhombohedron is almost exactly 90°, being 89° 57′, so that the symmetry resembles cubic, that of the diamond. A carborundum crystal exhibits no definite cleavage, but is distinguished clearly from a dark diamond by being doubly refractive, its two indices of refraction being $\omega=2{\cdot}786$ and $\epsilon=2{\cdot}832$ for sodium light, both of which are higher than the single refractive index of the diamond, 2·4175. Its specific gravity is 3·123, less than that of the diamond, which is 3·529.

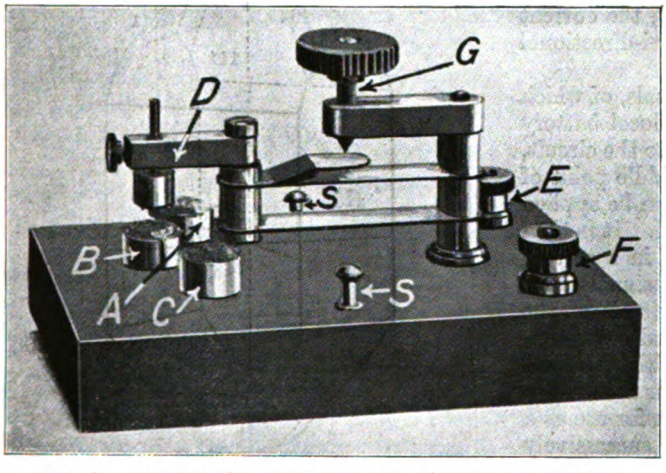

Fig. 1. Multiple Crystal Holder (by A. C. Cossar & Co.).

A carborundum crystal works well as a detector when clamped between two spring contacts, but the more trustworthy method of using it is to solder one end into a metal cap or cup, and to press the other end gently against a steel spring-contact, the amount of pressure being arranged to be delicately adjustable. It is often used, however, by being first wrapped round with a copper wire near one end, and then attached by the wire to the brass holder or clamp, while the free end presses against a steel spring. There appears to be no absolute occasion to obtain a single well-formed crystal, and indeed the pieces of carborundum seen in use have usually been composed of several attached, intergrown, or twinned crystals. But the particular point used as the contact point with the steel spring matters very considerably, and it often happens that if a good point gets broken off there is some difficulty in finding another equally good until several other parts of the crystal have been broken away. What constitutes a favourable contact-point, and whether a specific part or direction of a single individual crystal or merely a particularly shaped point or a definite character of surface be required, is a question urgently needing further investigation.

A recent form of multiple crystal holder suitable for experimental work is shown in Fig. 1. Crystals of various kinds are mounted at A, B, and C, in soft alloy in brass cups, which screw into sockets in the ebonite base. A movable arm, D, carries a sliding rod, which terminates either in a metal point or flat spring, or in another cup carrying a fourth crystal in the event of a double-crystal contact being desired to be used. Of the terminals E and F, one is in electrical connection with all three cups, A, B, C, and the other connects through the pillar and metal strips with the arm D. Screws, S, S, are also provided for attaching the base firmly to the rest of the apparatus in use. An ebonite-headed screw, G, serves for the delicate adjustment of the pressure of the contact. When carborundum is used the metal rod sliding in D usually terminates in a flat steel spring which can be adjusted by means of the screw G to press with the desired contact-pressure on the carborundum in A, B, or C.

As to what occurs when the electromagnetic waves reach the detector, certain definite facts have now been ascertained; but they leave the reason for the action almost an open question. The wave partakes of the nature of an alternating current, corresponding to the frequency of the

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oscillations occurring in the spark-gap of the transmitter; for the portions of the wave in opposite phases are of the nature of currents in opposite directions. It is found in actual practice, however, that the current in one direction gets through the contact of crystal and spring to so much greater an extent than the one in the opposite direction, that the practical effect is to convert the alternating current into a direct one, which passes on and affects the telephone or other receiver in the circuit. Owing to the superimposed effect of self-induction, and to the fact that the resistance of the crystal rectifier is greater for small than for large currents, the net result is as if in the passage through the crystal contact the "tops" or the "bottoms" of the waves (as diagrammatically expressed) are cut off, the current passing on in the form of uni-directional pulses to the telephone.

Sometimes, with certain crystals, of which carborundum is an example, a local battery and a potentiometer are added to the circuit, the lead being taken off the middle point of the battery, so that potential can be applied in either direction to the crystal. It is then found that a certain potential, in a certain direction, produces the loudest signals with any one crystal. Different crystals of the same substance, however, afford very considerable variations of effect with this local battery. In order to choose, for instance, a suitable crystal of carborundum for use as a detector, several crystals are successively submitted to an increasing electromotive force, and a curve plotted showing the current transmitted; this curve exhibits clearly the vast preponderance of current passing in one of the two directions, and also indicates a sudden rise of conductivity for some particular voltage in this direction, corresponding to the sensitive point found on the potentiometer. The actual amount of resistance on the part of the crystal does not appear to matter, so long as the curve afforded is of the right shape.

Another interesting point is that if no local battery be used, but the crystal be heated by a flame or hot filament, its sensitiveness rises with the temperature to the same maximum as that obtained by use of the battery. Also, a few exceptionally good crystals, when used alone, afford as strong effects as with either a local battery or extraneous heating. This appears to indicate that the effect of the local battery is merely to warm up the point of contact to the temperature for maximum sensitiveness, and it is of the highest importance to discover what it is which renders these crystals so exceptionally favourable.

Many other crystals have been found effective as rectifiers and detectors besides carborundum. One of the best, the so-called "perikon," consists of a crystal of one of the two double sulphides of iron and copper, chalcopyrite $CuFeS_2$ (a crystal of which is illustrated in Fig. 2) or bornite, Cu_3FeS_3, pressing against one of zincite, oxide of zinc, ZnO; it acts excellently without any

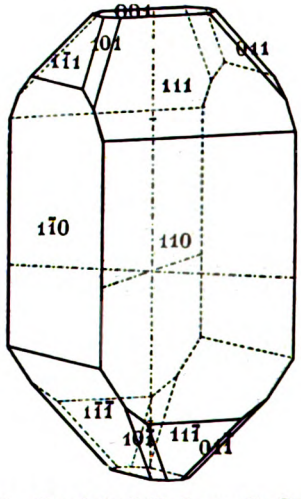

Fig. 2. Crystal of Chalcopyrite $CuFeS_2$ (tetragonal).

external battery. Another good combination requiring no battery consists of a pointed metallic rod, usually of copper or brass, pressing down upon a crystal plate (hexagonal) of molybdenite, sulphide of molybdenum, MoS_2. In this case the current usually flows from the metal to the molybdenite. A similar effect is obtained in the earlier rectifier of Pickard, in which a plate of crystallised silicon (which forms cubic crystals) is used under a copper rod. Iron pyrites (also cubic), FeS_2 (a crystal of which is represented in Fig. 3), and two of the forms of titanium dioxide, TiO_2, the tetragonal anatase (illustrated in Fig. 4), and the rhombic brookite, have also proved effective as crystal rectifiers and detectors.

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So far the most scientific attempt to unravel the mystery surrounding the action

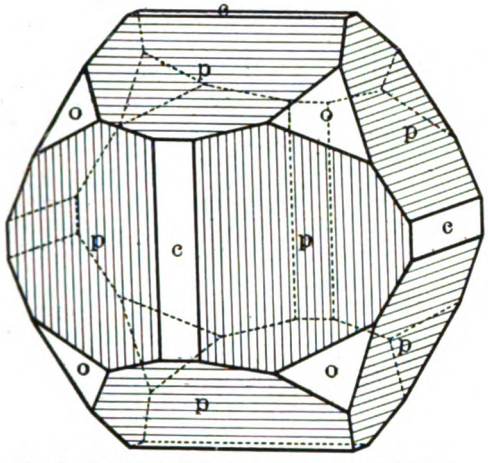

Fig. 3. Crystal of Iron Pyrites FeS_2 (cubic).

of crystals in this capacity has been that made by G. W. Pierce, who has established the following facts :

(1) All crystal rectifiers show a vastly predominating current transmission in one only of the two directions ; the amount of current which passes in this direction is often a hundred times as much as that in the other, and one case was measured in which it was four thousand times as much.

(2) Although all rectifying crystals show, in contact with metals, a large thermo-electric force, which differs in amount at different points on the crystal, the direction of the rectifying effect is often opposite to that observed on heating the contact, so that the rectifying effect is not a thermo-electric one.

A thermo-electric explanation is also negatived by the experiments of Austin, who found that with rectifiers of silicon and steel, carbon and steel, and tellurium and aluminium, the rectified current generally flows in the opposite direction to that produced by heating the contact.

In a communication to the Physical Society so recent as May 30th, Dr. W. H. Eccles emphasised the fact that when an electric current passes across such a light contact as that of a crystal detector, heat is liberated or absorbed in accordance with the laws of Peltier and Thomson, and is also generated in accordance with Joule's law.

He then discussed the nature of the curves representing these effects, and showed that the Thomson effect largely predominates. He states, however, that "there may be some coherer action mixed up with the thermo-electric 'rectifying' action." Prof. Fleming at the same meeting also referred to a similar set of curves prepared for him by Mr. P. R. Coursey, but stated that they did not fall in with any very simple theory of such rectifying detectors.

Pierce suggests, as a probable explanation, that the small contact surface of separation between crystal and metal (or other second body) permits the passage of electronic corpuscles more easily in one direction than the other. This would also explain the accompanying independent thermo-electric effect, provided, as is probable, the velocity of the electrons be suitably different at different temperatures.

This view would also appear to be connected with that expressed to the writer by more than one physicist—namely, that the effect is essentially that of "a point and a plate." For obviously it should be easy for electrons to stream from a point to a plate. But this is hard to reconcile with one of the experimental results of Pierce, that the rectifying effect is not only different in

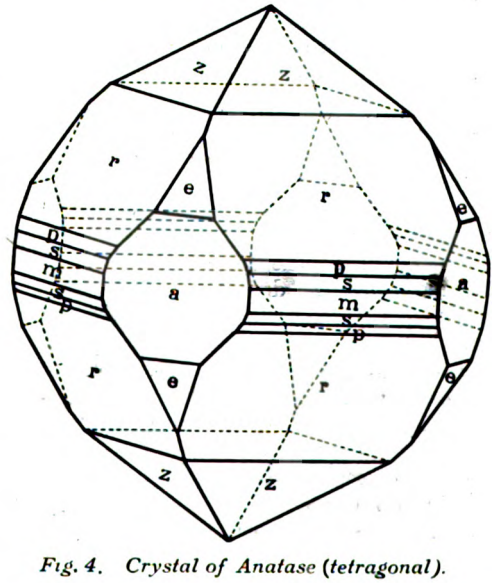

Fig. 4. Crystal of Anatase (tetragonal).

amount, but also in *direction*, at different points of the same crystalline substance.

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Also, there is very little loss of sensitiveness if the point be blunted, and in some cases good results were obtained with a surface of contact of four square millimetres extent. Another view expressed by experienced observers is that the cause is a slight chemical or electrolytic action, comparable with the idea that a thin film of iron or nickel oxide is produced at each contact when the filings coherer is at work, and then again reduced. Pierce, however, has definitely proved the absence of electrolytic polarisation in the case of crystal rectifiers, by direct experiment during a long period of time, using even very heavy currents and a raised temperature.

It will thus be obvious that this new property of crystals, by virtue of which they act as rectifiers and detectors of electro-magnetic waves, is one of the highest interest to the crystallographer, and one which calls for the most careful investigation. The chief objects of this article are to indicate the main lines which such a research should follow, to offer a few suggestions as to the possibilities, to set forth clearly what a crystal is, and to indicate the main results of previous crystallographic work which in the writer's opinion bear on the phenomenon.

A crystal is the form assumed by a definite chemical substance, when the latter is a solid at the ordinary temperature (or other temperature of formation), and its chemical molecules are able to approach each other so as to aggregate and mutually adjust themselves quietly and undisturbedly, with due deliberation, into the solid assemblage; this may occur either from the state of liquid (fusion) or of solution in a solvent (preferably from a solution only slightly supersaturated), or by direct condensation from the gaseous state without the intermediate formation of liquid. A crystal is a polyhedral body bounded by truly plane faces, mutually arranged in accordance with a definite plan of symmetry, of which there are 32 types (crystal classes), which group themselves into seven systems: the cubic, trigonal, tetragonal, hexagonal, rhombic, monoclinic, and triclinic.

This external symmetry is the expression of internal structural symmetry, that of the arrangement of the regularly deposited

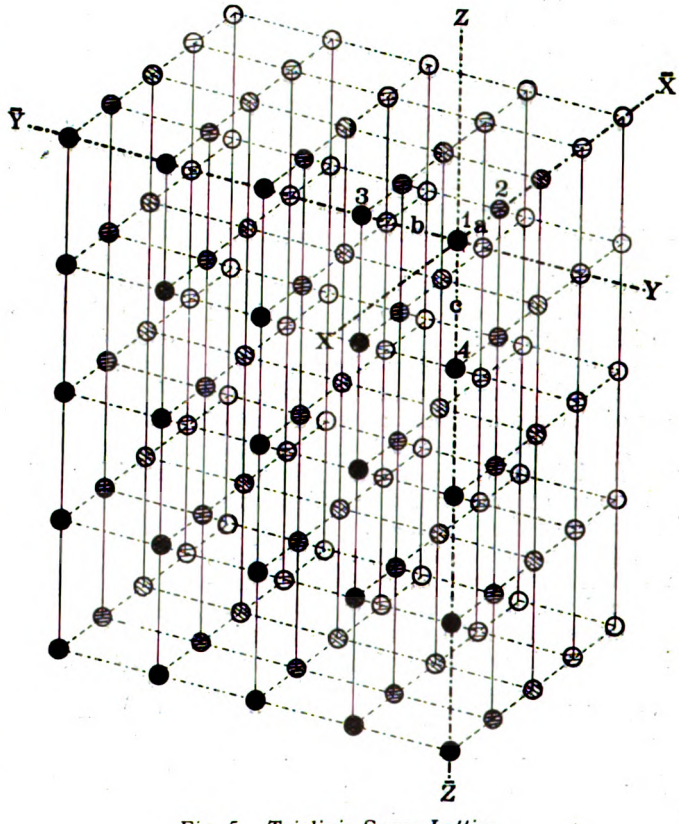

Fig. 5. Triclinic Space-Lattice.

chemical molecules, and ultimately of their constituent elementary atoms. These atomic ultimate units are so arranged that, if they be represented by points, the latter form one of the 230 homogeneous arrangements of points which are possible, compatible with such homogeneous structure as is characteristic of crystals. But the molecules themselves (that is, the molecular groups of atoms corresponding to the chemical formula), or symmetrically arranged small

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groups of molecules, form grosser structural units which it is convenient to distinguish. For if such molecular or polymolecular grosser units be each in turn represented by a point, then the crystal structure is such that the whole assemblage of such points, when joined by imaginary straight lines in the three directions of space, form a space-lattice. The most general (triclinic) form of space-lattice is represented in Fig. 5. Only 14 space-lattices are possible, among which the symmetry of all the seven crystal systems is represented, and no other. This molecular or polymolecular space-lattice (for each unit cell of the space-lattice is the home of the molecule or small group of molecules) is of intrinsic importance, inasmuch as its character determines the crystal-system to which the crystal shall belong, the positions and angles of mutual inclination of the crystal faces, and the occurrence of only such faces as comply with the fundamental crystal-law known as "the law of rational indices." For no faces are possible on the crystal except those which pass through the planes of points of the space-lattice. Any three points of the space-lattice constitute a plane, but it can readily be seen that not many such are possible besides those parallel to the cell-walls of the unit cell of the lattice, and as a matter of fact only the simplest are usually actually developed—namely, such as cut off unit lengths of the three edges (taken as axes) of the cell, or simple multiples of such lengths.

One significant consequence of the above facts is that the all-important space-lattice is also afforded by taking all similar (composed of the same chemical element) and similarly (identically) situated atoms throughout the structure—that is, by selecting any one atom from any particular grosser unit to act as its representative point, and doing exactly the same for every other grosser unit throughout the structure. Hence the planes of the space-lattice are those strewn with similar and similarly situated chemical elementary atoms. It is these planes which have recently been shown by the remarkable work of Laue, Friedrich, and Knipping to be capable of reflecting the excessively minute waves of the X-rays, probably the minutest form of electromagnetic wave motion, very much finer than the waves of light. The positions of these planes of similar and similarly situated atoms have been located thus experimentally in the crystals of zinc-blende, ZnS (a crystal of which is represented in Fig. 6); rock salt, NaCl; quartz, SiO_2; galena, PbS; fluorspar, CaF_2; magnetite, Fe_3O_4; and even in such complicated substances as alum, borax, cane-sugar, and mica, by these German investigators and by others working on their lines in this country. Hence the space-lattice is no myth of the imagination, but an experimentally proved reality, and is without doubt the fundamental groundwork of crystal structure. Although it is thus convenient to isolate the grosser units, the chemical molecules or arranged groups of molecules, on account of their representative points forming the

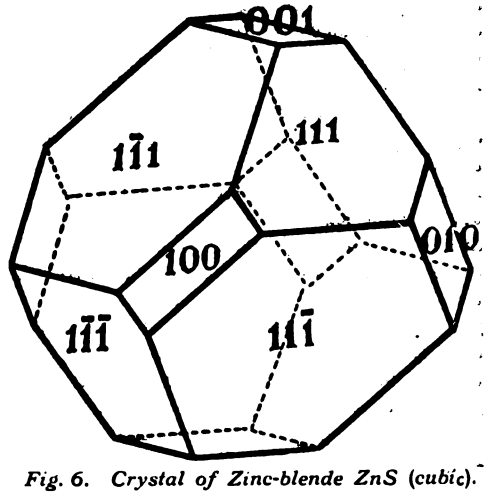

Fig. 6. Crystal of Zinc-blende ZnS (cubic).

space-lattice, in the crystal itself the demarcation between adjacent grosser units is eliminated, and the elementary atoms are the actual and ultimate structural units, arranged in accordance with one of the 230 point-systems.

It will thus be seen how very orderly and regular is the structure of a crystal, and it is doubtless due to this wonderful organisation that a crystal can act as a rectifier and detector for electric waves. It is obviously a naturally formed and ever-ready coherer, and for some reason yet to seek the use of a decoherer (the "trembler") is as unnecessary as it would be impossible to apply. Automatically, in some manner or other, the uni-directional current corresponding to

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part only of the wave is transmitted to the telephone. It is, indeed, a singular fact that the planes of similar and similarly situated atoms in a crystal are capable of reflecting the finest electromagnetic X-ray waves, and also of exercising a selective effect on the almost infinitely grosser electromagnetic waves used in wireless telegraphy.

Now, it is an interesting fact that no striking results have ever been obtained from numerous investigations on the growth of crystals under the influence of a magnetic field, and an explanation of this fact has been offered by Professor Otto Lehmann, whose name is so well known in connection with his fascinating work on "liquid crystals." He has proved that the "molecular orientative force of crystallisation" is a reality, and is that force which impels the chemical molecules to set themselves at close quarters in the regularly organised manner which has been shown above to be characteristic of crystals. For the act of crystallisation is not merely a question of the closest packing of molecules in a purely mechanical and happy-go-lucky manner, but the result of the operation of definite attractive and repulsive forces. When these are sufficient to cause the molecules to take up positions such that their centres of gravity or those of small groups of molecules occupy the points of a space-lattice, and then to set themselves further so that these grosser units (molecular or polymolecular) become strictly parallel to each other with respect to the configuration of the molecule (as regards the internal arrangements of its atoms), a solid crystal is produced. But in the cases of the extraordinary compounds brought to our notice by Lehmann, most of which are of complicated constitution (long chains of atoms) and of somewhat viscous, oily, or soapy character, the second stage is not accomplished, and the grosser units, probably the molecules themselves in these cases, are wobbly about their centres of gravity; the substance, therefore, either forms fluid crystals with rounded edges and mobile form, readily bent or broken, but as readily recovering themselves, or they are drop-like or even unbrokenly liquid in character, and yet exhibit the optical property of double refraction, and afford brilliant colours in polarised light, just like a solid crystal. The study of these bodies has led Lehmann to the conclusion that their molecules behave as if they were freely suspended astatic systems of magnets, which are constantly setting themselves, even while moving about as a liquid, in a crystalline space-lattice. He suggests further that the force in question, productive of crystallisation, is due to the action of the electronic corpuscles composing the elementary atoms rotating within the molecule, causing the molecules to act as magnets, the poles of which mutually attract and repel one another; and that pairs or small groups of four or more molecules thus arrange themselves alongside, in accordance with a definite plan, so as to produce astatic systems, forming a cubic or other less symmetrical assemblage. It has already been shown that crystals are just such assemblages of molecules or groups of molecules, and the whole astatic group in the latter case would correspond to the grosser unit above referred to, the unit of the space-lattice fundamentally governing the crystal structure.

Such an astatic system of molecules would be incapable of attraction by a magnet, as we have seen is the case, and would certainly produce a space-lattice arrangement. For differences in different directions would inevitably be involved in all but the most simple and perfectly symmetrical cases, with regard both to internal friction and the power of thermal expansion, as well as regards optical properties and doubtless also electrical conductivity and dielectric capacity. For the electrical properties of crystals are just as much functions of their symmetry as are the optical, thermal, and elastic properties. Lehmann points out that either electric currents or mechanically moved quantities of electricity, such as moving negatively electrified electronic corpuscles, can give rise to just such magnetic effects, and he suggests that these corpuscles are the true cause.

It will be obvious at once that if there be any truth in these speculations and experiments of Lehmann, the conclusion of Pierce, that transference of electronic corpuscles across the junction-point of crystal and metal plate is the reason for the action of crystals as rectifiers, takes on a new importance and comes to us in quite a new light and with greatly enhanced interest. For it is most natural to suppose that the electro-

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magnetic waves, on reaching the relatively minute point of contact of the crystal with the metallic plate, will cause some of the moving corpuscles to become detached from the system and to pass in one direction preponderatingly, owing to the directionally different nature of the crystal structure, or to the greater facility for streaming from the point, and with a velocity dependent on the temperature. Such an explanation clearly correlates the observed facts: (a) that a crystal acts as a more efficient coherer than a filings tube, being more perfectly and permanently arranged in orderly assemblage; (b) that a point-and-plate contact is the most efficient on the whole; and (c) that certain parts of a crystal act better than others. It is the writer's belief that the secret of finding a suitable point in the case of carborundum is the finding of a truly single individual crystal suitably orientated for maximum effect in the right direction, and with a clean solid angle, in which several interfacial edges meet, presenting its apex to the metallic plate. In a conglomerate crystal, a mass of intergrowths, twins, or parallel growths, it may not be easy always to discover such a spot—a supposition which agrees exactly with the observed facts.

In conclusion, it may not be without interest to enumerate the lines of future research which are necessary, in the writer's opinion, in order finally to settle this question of such high interest to the crystallographer. A series of exhaustive experiments should be made in the first place with the very best procurable single individual crystals, of the various pure substances found so efficacious as rectifiers. They should be used in a complete series of well ascertained, crystallographically definite directions and orientations, in order to ascertain quantitatively the effect of direction within the crystal and of position of the point presented to the plate; that is, a large number of points all round the crystal should be presented in turn, both ends of every important direction line within the crystal being thus investigated. Experiments should also be made with artificially pointed crystals of different degrees of bluntness, and with naturally pointed crystals (pyramids or bipyramids) of as many degrees of steepness as the pyramidal forms developed on the crystal permit. And lastly, crystals such as tourmaline should be tried, which belong to classes of symmetry of lower than the full systematic symmetry, particularly those which are differently terminated by virtue of the absence of an equatorial or other plane of symmetry possible in the system, and which are distinguished in consequence by the presence of what is known as a polar axis. For it is just such crystals as these which exhibit the interesting phenomena of "pyro-electricity" and "piezo-electricity"—that is, the development of opposite electric polarity at the two terminations of the polar axis on warming the crystal or permitting it to cool, or by compressing it along the axis and again releasing the pressure.

The experiments now adumbrated would take full cognisance of the already well-known electrical properties which are purely functions of the symmetry, such as electric conductivity, thermo-electric character, and dielectric capacity. In many cases it may be very difficult to obtain perfect single crystals, and the experiments may show that it is quite unnecessary to expend time in doing so. But only by such a systematic series of investigations can we get to the bottom of this most interesting property of crystals. Moreover, in the course of such an investigation it is quite possible, and even probable, that very much more sensitive crystal rectifiers and detectors may be discovered than the best at present in use, a result which of itself would be of considerable value in the further development of long-distance communication without wires.

The Bureau of Navigation has issued a statement showing that during the first four months of the operation of the Act to regulate radio communication, which took effect on December 13th, 1912, the Department of Commerce, through the Bureau of Navigation, has issued 3,407 licences to wireless operators and stations in the United States. The first grade commercial operators' licences number 1,279 and the second grade 186, while 1,185 amateurs have been licensed. So far 46 American ship stations and 18 coast stations have been licensed, and this branch of the work will now proceed more rapidly.

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Crystal Detectors and Electrothermal Action.

IN a paper to the Physical Society, Dr. W. H. Eccles deals from a new theoretical standpoint with "Electrothermal phenomena at the contact of two conductors," and develops a theory of the action of crystal detectors.

In his introductory paragraphs he says:—

"When an electric current is caused to pass across the interface between a pair of conducting masses, heat is in general liberated or absorbed in accordance with the law of Peltier. When the masses are in contact over a very small area, as, for example, when a cylinder of graphite is laid across a copper wire, there may be, in addition, appreciable generation of heat in accordance with the law of Joule. If the substances constituting the contact are bad conductors of electricity and of heat, and if they stand far apart in the thermoelectric series, the phenomena arising when a current is forced across the joint become very striking, for in such circumstances relatively large amounts of heat may be developed, the heat is conserved, and therefore the thermoelectric effects enhanced.

"It is evident that the thermoelectric forces called up by the local heating may assist or may oppose the E.M.F. applied to produce the current and that the phenomena of a symmetric conduction at once arises. But besides the Joule and Peltier effects, the Thomson effect may contribute to the phenomena. In the case of bad conductors of heat the temperature gradients very near the contact will be very steep, and thus the Thomson effect will be localised in the immediate neighbourhood of the contact.

"Further than this it is obvious that, on account of the temperature changes, the portions of the substances near the contact will suffer a change in the magnitude of their electrical resistivity. It has been shown* that this effect alone leads to remarkable and important results, and is sufficient to account for all the principal features of the single-point coherer used in wireless telegraphy.

"The thermoelectric forces and the changes of electrical resistance that arise from differences of temperature are much greater in combinations of such substances as iron pyrites than in combinations of ordinary metals. A pyrites-lead couple yields an E.M.F. some 200 per cent. greater than a bismuth-lead junction, between the same extremes of (ordinary) temperatures; while the temperature coefficient of resistance of pyrites is probably four times as great numerically as that of copper. But the thermal conductivity of pyrites is so very much smaller than that of lead that all these thermoelectric phenomena are greatly accentuated in the former case. Contacts between non-metallic conductors are of special interest, for the reason that the bulk of the wireless telegraphy of the world is carried on by aid of detectors that consist of nothing else than a contact involving at least one non-metallic conductor.

"The thermoelectric constants of such substances as pyrites, zincite, carborundum, etc., are not easy to measure accurately, and their coefficients of increase of resistance with temperature are exceedingly difficult to determine. The author has made numerous determinations, and has found that all the materials examined follow with fair precision the ordinary thermoelectric law that their thermoelectric powers are linear functions of the temperature, and also that their temperature-resistance coefficients are all large and negative."

* "Proc." Physical Society of London, Vol. XXII. p. 869.

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The writer goes on to consider a circuit including a loose contact, such as that formed by a piece of pyrites pressing against a piece of metal; the other junction making a very good contact, so that its temperature remains unchanged.

"Let an E.M.F. be applied to the circuit in any manner so as to produce a current in the direction opposite to the E.M.F. that would be produced by heating the contact. The heat liberated near the contact is, per absolute unit of electricity flowing through the contact, equal to the thermoelectric force e plus the heat absorbed at the cold junction.

"This heat tends to be concentrated in a small volume of the substance near the contact, but is dispersed continually by thermal conductivity and radiation. We will assume that the rate of loss of heat by these agencies is, as a whole, proportional to the excess of temperature of the junction over its surroundings. The rise of temperature causes an alteration of the electrical resistance of the joint; let the true resistance at any temperature above the temperature of the surroundings be expressed by $\rho(1+\gamma\theta)$ where γ is a temperature coefficient dependent on both the substances at the contact."

His mathematical investigation leads to the obtaining of an equation for the current y sent across a typical detector-junction, in terms of the P.D. between the extreme ends of the conductors which vary in temperature. If this P.D. be represented by x, the equation obtained, omitting negligible terms, is

$$ax^2y^2+cxy^2+bxy-x+\rho y=0.$$

The constants a, c, b in this equation are mainly dependent on the Thomson effect, the change of resistance with temperature, and the Peltier effect respectively. If the part of the circuit which undergoes no appreciable temperature-change possesses the constant resistance r, and the applied E.M.F. be denoted by e, then $x = e - ry$, and the steady current *characteristic curve* as usually drawn from observations of applied E.M.F., and consequent current is identically that obtained by applying to the curve drawn from the above equation a homogeneous shear of amount r parallel to the axis of x.

The author proceeds to deal with particular cases of this equation, assigning various values to the constants a, c, and b, and showing the derived curves.

The paper itself should be consulted by all who are interested in the subject; it is too long for a full abstract to be given here. Among other interesting conclusions arrived at, it is indicated that when the constant a is positive, the current produced by a definite voltage is greater when the voltage is negative than when it is positive; while when a is negative or zero the positive voltage produces the greater current. Now, various writers (if we remember rightly, Professor Pierce in particular) discredit the theory that crystal-rectification is due to thermoelectric action, on the ground that when some such contacts are warmed by direct communication of heat the thermoelectric force is in the opposite direction to the current produced by the rectifying action. Dr. Eccles considers that this argument is a fallacy; for the observation of the direction of the thermoelectric force produced by direct heating shows only the sign of the Peltier effect and not the sign of the Thomson effect in the circuit, and thus ignores the sign of the important constant a.

There is, we think, another argument against the thermoelectric explanation of crystal-action—the fact, obtained experimentally, that the maximum current produced thermoelectrically may be thousands of times less than the rectified current produced from an alternating current which gives rise to the same increase of temperature at the contact.

We do not know whether the experiment referred to was carried out in such a way that the two cases could truly be compared, but we should doubt it, since the current produced by rectification would depend on what point of the curve was being worked on.

We have submitted the above point to Dr. Eccles, and he takes the same view, pointing out that his mathematical treatment shows that if the E.M.F. e is adjusted to a sharp bend in the curve, the rectified current might be enormous compared with the thermoelectric current. Thus things which show no thermoelectric E.M.F. may be good rectifiers, and he quotes as an example a pair of pieces of galena, which form a very good rectifier at a certain E.M.F. (about $\frac{1}{2}$ volt), but which show no thermoelectric action.

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THE MARCONI INTERNATIONAL

THE Report of the Directors of the above Company and the Statement of Accounts for the year ending December 31st, 1912, was presented at the Thirteenth Ordinary General Meeting of the Company, held on Monday, June 23rd, 1913.

It will be observed from the Accounts that the business of the Company has continued to show very satisfactory progress during the year under review, the net profit for the year amounting to £24,435 17s. 11d. after deducting £10,780 13s. 1d. for depreciation and allowing for debenture interest, as compared with £15,027 15s. 7d. in the preceding year.

The revenue from ships' telegrams, traffic, subsidies, etc., amounts to £100,325 3s. 10d., showing again a substantial increase over the amount of £64,165 16s. 8d. for the year 1911 and £40,535 15s. 8d. for the year 1910.

Some further indication of the substantial development of the Company's business is shown by the number of telegraph stations owned and worked by the Company on board ships on the high seas, the number of which increased from 250 at the end of 1910 to 350 on December 31st, 1911, and on December 31st, 1912, the actual number of stations in work had increased to 580. To the present date progress continues on much the same scale, the number of ships actually equipped by this Company being 686, and con-

Dr. BALANCE SHEET,

	£ s. d.	£ s. d.
To CAPITAL—		
Authorised.		
350,000 Shares of £1 each	350,000 0 0	
Issued.		
204,056 Shares, fully paid		204,056 0 0
„ 6,250 5½ PER CENT. 1ST MORTGAGE DEBENTURES OF £20 EACH ...		125,000 0 0
„ CREDITORS		72,566 7 7
„ RESERVE FOR REPAYMENT OF DEBENTURES		1,750 0 0
„ PROFIT AND LOSS ACCOUNT—		
Balance as per last account, December 31st, 1911	18,646 1 3	
Deduct—		
7 per cent. Dividend for 1911 ... ... £14,283 18 5		
Reserve for Repayment of Debentures ... 1,750 0 0		
	16,033 18 5	
	2,612 2 10	
Add—		
Balance of account for the year ending December 31st, 1912 ...	24,435 17 11	
		27,048 0 9
To Contingent Liability on shares in Associated Company, £200.		
		£430,420 8 4

Dr. PROFIT AND LOSS ACCOUNT for

	£ s. d.
To SALARIES AND DIRECTORS' FEES	9,418 9 8
„ TRAVELLING EXPENSES, OFFICE RENTS, LAW CHARGES AND SUNDRY EXPENSES ...	6,310 0 5
„ EXPENSES OF SHIPS' STATIONS, including depreciation of Plant and Apparatus ...	53,551 15 7
„ DEBENTURE INTEREST	6,609 0 3
„ BALANCE CARRIED TO BALANCE SHEET	24,435 17 11
	£100,325 3 10

Report of the Auditors to the Shareholders.

We have audited the above Balance Sheet. The Plant, Apparatus, Furniture and Stores have been we have required, and in our opinion such Balance Sheet is properly drawn up so as to exhibit a true explanations given to us and as shown by the Books of the Company.

LONDON, *June 12th*, 1913.

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MARINE COMMUNICATION Co. LTD.

siderable additional orders are in hand. There are now some 1,700 ships of different nations, exclusive of ships of war, fitted with Marconi wireless stations.

With every prospect of the Company's business continuing to show further substantial development, for which additional capital will be required, it is the intention of the Directors in the early future to place a further portion of the unissued capital, and this in the first instance will be offered to the Shareholders.

The Directors recommend the payment of a dividend for the year 1912 at the rate of 10 per cent., which will absorb the sum of £20,405 12s., and to allocate the sum of £3,500 to the repayment of Debenture Account, leaving the sum of £3,142 8s. 9d. to be carried forward.

On July 31st, 1912, Mr. Edgar St. Paul de Sincay retired from the Board, and Mr. Maurice Travailleur was elected in his place.

The retiring Directors are Major Samuel Flood Page and Mr. Alfonso Marconi, who, being eligible, offer themselves for re-election.

The Auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for re-appointment.

December 31st, 1912. Cr.

	£	s.	d.
By Plant, Apparatus, Furniture and Stores	144,847	0	4
„ Consideration for Licence and Rights and Shares in Associated Companies	228,936	11	7
Note.—The Licence and Rights are subject to the provisions of four Agreements between this Company and four Associated Companies, under which this Company received Shares in Associated Companies for this Company's rights in Canada, Argentina, Uruguay, and all European countries and their Dependencies except Great Britain and Ireland and Italy.			
„ Debtor Balances	40,222	12	3
„ Debenture Discount	14,843	15	0
„ Cash at Bankers and in Hand	1,570	9	2
	£430,420	8	4

the Year ending December 31st, 1912. Cr.

	£	s.	d.
By Ships' Telegrams, News Service, Traffic and Ships' Subsidies, Rentals and Sundry Receipts	100,322	17	10
„ Transfer Fees	2	6	0
	£100,325	3	10

GODFREY C. ISAACS, *Director.*
HENRY S. SAUNDERS, *Director.*

certified by representatives of the Company. We have obtained all the information and explanations and correct view of the state of the Company's affairs according to the best of our information and the

COOPER BROTHERS & CO., *Chartered Accountants.* } *Auditors.*

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The American Marconi Company

Annual Meeting and Payment of First Dividend

THE annual meeting of the Marconi Wireless Telegraph Company of America was held on June 16th, at the New Jersey offices of the company, 15, Exchange Place, Jersey City. The following is the official report of the proceedings:

The meeting, being a very important function, was largely attended, no less than a million shares being represented in person and by proxy. The meeting was duly called to order, and on motion duly made and seconded the President, the Hon. John W. Griggs, took the Chair, and Mr. John Bottomley was nominated secretary of the meeting.

Whilst the voting was in progress, the Chairman addressed the meeting substantially as follows:

"Gentlemen,—In reviewing the operations of the company during the past year, we are gratified to find a degree of growth and advancement that should be very satisfactory to the shareholders, as it is to the officers of the company. It is a striking truth that heretofore the world at large has reaped the greatest benefits from the marvellous work of Mr. Marconi, while those who have furnished the funds to carry on and finance the developments of the wireless system of communication in America have as yet had no returns in dividends earned and paid. The navies of the world Powers, as well as the merchant ships, now sail the perilous seas with an assurance of safety and protection immeasurably greater than before, because the Marconi wireless has brought within their call every sister ship of every nationality within a radius of two hundred miles to answer calls for help in time of distress. The debt of humanity to Mr. Marconi for life and property saved is already enormous. The comfort that comes to hundreds of thousands of passengers who cross the Atlantic on the great liners because the wireless is aboard to give them news of friends at home is a distinct addition to the general sum of human happiness. To accomplish these beneficent results the public has contributed nothing; the genius that has devised has been that of Marconi; the capital that has enabled him to carry out his wonderful work has been that of private stockholders. It is to be regretted that our own Government, which has so freely made use of the fruits of Mr. Marconi's inventive genius, has not yet in any way made the slightest recognition of the value and importance of his work. The magnetic telegraph was a wonder-working invention; the extension of its principles to the ocean cable made another great step in the advance of world-wide communication: but when Marconi marshalled the wild waves of ethereal energy, reduced them to orderly control, and made them carry with the speed of light the words of men through the vast wastes of space, he accomplished a miracle, surprising, stupendous—almost awe-inspiring. It is gratifying, however, to know that the great public has had faith in the success of the invention, and has furnished ample funds to carry on and establish the great designs of the inventor. After years of experimental work the time has come when we see the practical results in a commercial way, and we have satisfactory reasons to expect that substantial profits are to accrue to those who have supported the enterprise with their money.

GROWTH OF BUSINESS.

"The growth of your company's business in the last year will be best appreciated from a comparative statement. The net traffic receipts for the years 1905, 1906, 1907, 1908, 1909, 1910, 1911 and 1912 were as follows:—

1905	$18,358.29
1906	37,195.52
1907	53,558.01
1908	50,191.32
1909	60,999.57
1910	63,868.93
1911	67,941.93
1912	109,943.10

"The large increase in receipts for the year 1912 is mostly due to the acquisition of the fleet of boats heretofore equipped by the United Wireless Telegraph Company, which boats came under the supervision and control of your company in the month of July last. A comparison of the number of messages and words sent in the years 1910, 1911 and 1912 is interesting: In 1910, 31,051 messages consisting of 407,173 words were sent. In 1911, 41,000 messages consisting of 550,000 words were sent. In 1912, 227,944 messages consisting of 3,863,098 words were sent. There are now equipped by the Marconi Wireless Telegraph Company of America more than 450 ships of the American mercantile marine, and with the addition of the shore stations there are now equipped by the company over 500 stations on the Atlantic and Pacific coasts. We are justified in saying that practically all commercial vessels flying the American flag are equipped with the Marconi apparatus as supplied, operated and controlled by this company. Contracts which have heretofore been placed at a basis that does not satisfactorily recompense the company for the work and labour entailed in operating the stations thereunder are being re-formed, and the steamship companies, seeing that it is impossible for the company to continue to do business profitably at the low rates hitherto prevailing, have, with signal fairness in almost every instance, agreed to an amelioration of the contracts, and it is expected that shortly the general run of such contracts will be on a basis that is much more remunerative.

TRANSATLANTIC COMMUNICATION.

"Gratifying as these figures are, they are only a small thing compared with the results that must follow when direct communication is established between the United States and Great Britain. In the report of the directors to the stockholders is set forth the progress that has been made towards this end. We are assured by our engineers and contractors that the co-operating stations in New Jersey and Wales will be completed by next November. Allowing for all necessary delays in

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adjusting and trying out the stations, active commercial business across the Atlantic should be going on by the first of next year; thus the two most important nations of the world will be closely bound together by invisible, intangible, immaterial bands, and a new, additional and less expensive service will be furnished not only for the business world, but also for the Press, the Governments and for private and social purposes, realising an increase of income and profit to the shareholders which we have every reason to believe will be substantial and gratifying. The plans of your directors do not stop however, with the Anglo-American stations. Already well under way is the construction of co-operating stations at San Francisco and in the Sandwich Islands. From Honolulu we look beyond to service connection with the Philippine Islands, thence to Japan and China—an American Imperial chain. As stated in the report of your directors, a contract has been entered into with the Norwegian Government for the erection of co-operating high-power stations in Norway and the vicinity of New York for the purpose of conducting a commercial wireless business between Northern Europe and America. This contract is for a definite period of 25 years, and its terms are favourable to the wireless companies participating therein. The contract awaits the ratification of the Norwegian Parliament, which we are advised will in due time be obtained. It is also in contemplation to establish communication between various countries in South America and the United States by similar long-distance high-power stations.

VALUE OF THE SYSTEM.

"The ability of the Marconi apparatus to transmit and receive messages over vast distances has been fully demonstrated through the experiments of Mr. Marconi. A Committee of the Parliament of Great Britain has made a thorough examination of the various wireless systems that are claiming the attention of the world, and the following extract from their report will be, I am sure, of the highest interest to Marconi shareholders. They say:

"'We report, therefore, that according to our investigation the Marconi System is at present the only system of which it can be said with any certainty that it is capable of fulfilling the requirements of the Imperial Chain.

"'The directive aerial used in the Marconi System has the advantage of not requiring very great height and of giving preference in the desired direction.'

"In view of future operations on the Philippine Islands we have had one of our engineers out there for some time, who has equipped a 5 k.w. set at Zamboanga, and under date of April 24th we have received the following advice of the work which that station is doing:—

"'I beg to advise that the 5 k.w. set is now in operation. The Bureau of Posts is using it a number of hours each day in handling its regular business between this station and Jolo Malabang Balvo and Puerito Princessa. As regards the strength and tone of signals, the Bureau is very much pleased with the set. On Sunday afternoon we were testing with Olzanpo, which station is 150 or 200 miles north of Manila, and our signals were perfectly received. The army transport "Merritt," which arrived in port yesterday, reports that she heard our signals in Manila Bay and all the time on the trip to Zamboanga.'

"The recent great development in the size and speed of sea-going vessels has enormously increased the responsibilities of the officers commanding and navigating them, and it has been necessary, in order to minimise dangers of collisions or groundings, to reduce the speed of these vessels in foggy weather, with a consequent loss of much valuable time and money, and even when precaution has been taken accidents are not infrequent. The Marconi Companies have accordingly been led to give considerable attention to the development of an instrument which is now aptly known as 'The Wireless Compass.' The wireless compass is a combination of some of Mr. Marconi's recent inventions, and the Bellini-Tosi patents, the sole use of which for the United States has been secured by your company. The Marconi wireless compass is quite independent of weather conditions, and by its use the position of a ship with regard to any coast station can be determined, and the direction of an approaching or overtaking ship can be found. The apparatus is of very simple construction, which is another strong point in its favour. Your company anticipates that the manifest advantages to shipowners of this instrument will cause it to be widely adopted, and its sale should add considerably to the revenue of your company.

PROFIT AND LOSS ACCOUNT.

"The confidence of the people in the Marconi system was shown in the large and full subscriptions to new stock in May of last year, whereby your company has been supplied with ample funds for the establishment of the extensive international stations that had been referred to. These funds have been temporarily invested by your directors in securities of the most approved character, and are earning a fair rate of interest. The general profit and loss account for the year ended January 31st, 1913, a copy of which has been sent to each stockholder, shows a surplus of profit at the end of the year of $224,483.65. Your Board of Directors, in view of the very large cash fund on hand, have deemed it fair and prudent to distribute to the stockholders a dividend of 2 per cent. upon their capital stock out of this balance of profit and loss shown by the statement of operations for the past year. In the absence of any unforeseen disturbance or setback in the course of present prosperity, the Board will be able to continue the payment of dividends for each six months of current business hereafter, the amount of which cannot at the present time be precisely estimated. I take this occasion to congratulate you upon the safe and sound condition of your company's affairs, and to express the most earnest hope for the realisation of those reasonable expectations of profitable business that have been so generally entertained on the part of the stockholders of this company."

The polls having been closed, it was found that the following had been elected to serve as directors for a term of five years, or until their successors shall be elected:—Hon. John W. Griggs, James M. Townsend and Marcus Goodbody. The telling also reported a large vote in favour of the amendments to the by-laws, whereby the fiscal year is made to end December 31st instead of January 31st, as heretofore; also permitting the directors to elect additional Vice-Presidents, assistant treasurers and assistant secretaries.

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STATEMENT of ACCOUNTS of the AMERICAN MARCONI CO.

For the Year ending January 31, 1913.

CAPITAL - - - - - $10,000,000

DIRECTORS.

HON. JOHN W. GRIGGS, President.
COMMENDATORE G. MARCONI, LL.D., D.Sc., First Vice-President.
JOHN BOTTOMLEY, Second Vice-President, General Manager, Secretary and Treasurer.
GEORGES DESOUSA, Assistant Treasurer.
JAMES M. TOWNSEND.
JAMES W. PYKE.
EDWARD L. YOUNG.
GODFREY C. ISAACS.
MAJOR S. FLOOD-PAGE.
JAMES R. SHEFFIELD.
JOHN L. GRIGGS.
KENNETH K. MCLAREN.

ACCOUNTANTS.
DELOITTE, PLENDER, GRIFFITHS AND COMPANY.

COUNSEL.
HON. JOHN W. GRIGGS. SHEFFIELD BENTLEY AND BETTS.

TRANSFER AGENTS.
MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

REGISTRARS.
EQUITABLE TRUST COMPANY.

OFFICES OF THE COMPANY.
WOOLWORTH BUILDING, No. 233 BROADWAY, NEW YORK. 15 EXCHANGE PLACE, JERSEY CITY.

GENERAL PROFIT AND LOSS ACCOUNT AND BALANCE SHEET

For the Year ended January 31, 1913.

GENERAL PROFIT AND LOSS ACCOUNT.

Administration Expenses, including Salaries of Directors, Executive Officers and Consulting Engineer, Rents, Taxes, and General Office Expenses, Reserves for Outstanding Liabilities, etc.		$79,650.73	
Legal, Patent and Stock Transfer Expenses		10,357.42	
Depreciation on Buildings, Equipment, etc.		30,989.36	
Profit carried to Balance-sheet		211,245.57	
		$332,243.08	
Profit from Operation of Land and Ship Stations, Sale of Apparatus, etc. ..			$170,694.79
Interest on Temporary Investment of Surplus Funds			161,548.29
			$332,243.08

BALANCE SHEET, JANUARY 31ST, 1913.

ASSETS.			LIABILITIES.		
Cash in Banks, on Hand and at Call:			Capital Stock—		
Cash in Banks and on hand	$308,491.11		Authorised: 2,000,000 Shares, par value $5.00 each	$10,000,000.00	
Bankers' Certificates of Deposit	775,000.00		Less: Subscribed for but not yet issued 119,486 Shares, par value $5.00 each	597,430.00	
Bankers' Collateral Loans	2,320,000.00			$9,402,570.00	
		$3,403,491.11	Less: Stock held in Treasury	500.00	
Investments and Loans (at cost):					$9,402,070.00
Railway Bonds and Notes	$2,108,502.56		Sundry Creditors and Credit Balances		195,857.47
Bankers' Time Collateral Loans	250,000.00		Reserves for Outstanding Liabilities, Rentals Prepaid, etc.		44,032.33
Foreign Government Bonds	97,875.00		Profit and Loss Account—		
Municipal Loans	75,000.00		Balance, January 31st, 1912 (adjusted).. ..	$13,238.08	
Bankers' Time Certificates of Deposit	100,000.00		Profit for year ended January 31st, 1913, per Profit and Loss Account ..	211,245.57	
Shares of other Companies	1,470.00				224,483.65
		$2,632,847.56			
Interest Accrued		22,717.82			
Sundry Debtors and Debit Balances, after providing Reserve for Doubtful Accounts		309,684.56			
Patents, Patent Rights and Goodwill		2,691,215.29			
Real Estate and Buildings, Machinery, Plant, Apparatus at Works, Land and Ship Stations, after providing Reserve for Depreciation of Equipment		806,487.11			
		$9,866,443.45			$9,866,443.45

We have audited the accounts of the Marconi Wireless Telegraph Company of America in New York and San Francisco for the year ended January 31st, 1913. We have duly verified the Balances in Banks and on hand, and the securities representing the Investments, as set forth in the Balance Sheet, have been produced for our inspection.

No provision has at present been made for writing off any portion of the book value of Patents and Patent Rights.

Subject to the correctness of the appointment of Cost Values of Assets acquired during the year, we certify that the above Balance Sheet, in our opinion, fully and fairly sets forth the position of the Company as disclosed by the books as at January 31st, 1913.

New York, *June 5th*, 1913.

DELOITTE, PLENDER, GRIFFITHS AND CO.

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The Russian Marconi Company

Annual Meeting and Dividend

USE OF MARCONI SYSTEM IN ARMY AND NAVY

THE general meeting of the (Marconi) Russian Company of Wireless Telegraphs and Telephones was held on 31st May (Russian style) in St. Petersburg. The following is the official report of the proceedings:

Mr. M. G. Salberg read the report of the directors, which stated: A year ago, in view of the orders which the company then had in hand, and the rapidly increasing growth of the business, the Board informed you in its report that there were good reasons to expect a satisfactory result for the year 1912. The present balance sheet fully justifies the expectations expressed by the directors at the general meeting in May, 1912, and it is a matter of considerable satisfaction to your Board to be able to place before you accounts which show so marked an improvement as compared with those of the preceding year. Looking at the figures you will find, on the credit side, that there is a gross profit of 250,189.64 roubles on completed contracts as compared with 62,850.17 roubles for the preceding year, which, after deducting a sum of 109,390.46 roubles to cover the company's general expenses and percentages, leaves a net divisible profit of 139,801.58 roubles as compared with a loss of 39,058,78 roubles for 1911. The only other point in connection with the balance sheet which calls for special notice is in respect of the company's freehold property. This property is shown in the balance sheet at cost price, but the directors desire to call attention to the fact that the land has increased considerably in value and that land in the immediate vicinity, less favourably situated, is commanding more than double the price which the company paid for their freehold property at the time of its purchase only four years ago.

GENERAL EXPANSION.

During the year 1912, owing to the rapidity with which the business extended, it was found necessary to enlarge the premises and increase the machinery and staff. The estimates for 1913 are therefore submitted to you at an increased figure. The development of the company's business in 1912 is particularly marked by the wide-spread adoption of our stations by the Russian Admiralty. In previous years it has been a matter of regret to the Board that comparatively few orders were received from the Admiralty, whose stations formerly were almost exclusively equipped with apparatus of our competitors; in 1912, however, the position was entirely changed, and a number of large and important orders were received both for the erection of shore stations and for the equipment of vessels of the Russian marine. Of special significance is the fact that among the orders completed in 1912 for the Admiralty was the conversion of thirty-six ship stations of the Russian Navy from our chief competitors' system to our own. Among the company's other developments in 1912 was the introduction of a special type of light, portable station for the use of the Russian cavalry. Two such stations were worked by the Imperial Hussars during the summer manœuvres of 1912 with the greatest possible success, a special demonstration of their capabilities being afterwards given in the presence of the Emperor. As a direct result of the successful trials of these stations, a special Commission is now sitting with a view of definitely deciding the type of cavalry station most suitable to the needs of the army, and large orders for these stations may eventually be expected.

ARMY AND NAVY CONTRACTS.

Up to the present time the Russian Commercial Fleet has taken little or no advantage of the many facilities offered by wireless telegraphy; in 1912, however, a beginning was made by the equipment by this company of six vessels belonging to the Russian Volunteer Fleet. A new law is now under consideration by the Government to make it compulsory for all passenger-carrying vessels to be equipped with wireless telegraphy, so that in due course a large field should also be opened up in this direction. In the present year (1913) a large and important contract has been entered into with the Russian War Office for the erection of a powerful station at Nikolaeff and for the reconstruction of the station at Ourjumka; in addition to the above, a further contract has been entered into with the Admiralty for the conversion of fifty-one ship stations from our principal competitors' system to our own. Altogether the company has new contracts in hand for 1913 amounting to over 900,000 roubles, whilst further large and important orders may confidently be expected as soon as the Budget for 1913 has been confirmed. It will be seen from the above that the company's business is rapidly increasing and the field for wireless telegraphy is spreading with ever-growing rapidity owing to the development of the military and naval strength of the country and of the vast tracts of land where no form of telegraphic communication exists. The company's business having outgrown its resources, the directors have had to seriously consider some means of coping with this situation. In view of the conditions obtaining in Russia large sums have to be kept available in order to make a deposit with the Government as guarantee, with every order received. With a comparatively small capital this has proved a serious drain on the company's resources, as it has not left sufficient funds available to carry out the actual work of construction even under the most favourable conditions, necessitating therefore the borrowing of money and consequently reducing the profit owing to the high rates of interest which have had to be paid.

In addition to this it is considered desirable to purchase the land which is at present rented for trials and demonstrations in the neighbourhood of the company's works. No time should be lost in doing this, as otherwise the company may find itself in an unfavourable position, for it would be very inconvenient to carry out tests on ground anywhere but in the immediate vicinity of the works. In view of these circumstances, therefore, and in

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order to place the company's affairs on a more profitable basis in the future, the directors beg to recommend the increase of the company's capital by a new issue of shares to the nominal value of 1,200,000 roubles. As the result of the ever-increasing business of the company, it is impossible to avoid indebtedness, and the Board of Directors ask you to authorise them to pledge the company's credit with Government and private institutions, if necessary, up to 1,000,000 roubles. In addition to the accounts and balance sheet the directors also submit for your approval the estimate of expenditure for 1913, amounting to 229,500 roubles. The directors submit for your approval and passing the following resolutions: (1) To confirm the report of the Board of Directors for the period from 1st January to the 31st December, 1912, and the balance sheet as at 1st January, 1913, and the distribution of the profits. (2) To approve estimate of expenditure for the year 1913, amounting to 229,500 roubles, exclusive of any interest which may have to be paid. (3) To authorise the Board to take sums on credit in Government and private institutions, issuing cheques and bonds on behalf of the company up to the sum of 1,000,000 roubles. (4) To authorise the increase of the capital by the issue of a new series of shares to a nominal value of 1,200,000 roubles. Besides passing the above resolutions, the general meeting, as per sections 25 and 28 of the company's charter, has to elect—(*a*) two directors who retire by rotation, and one to fill the vacancy on the Board; (*b*) five members of the revisionary committee.

PROPOSALS AGREED TO.

It was unanimously decided: (1) To confirm the report for the period from 1st January to 31st December, 1912, and the balance sheet as at 1st January, 1913. The profit as per report, of 139,801.58 roubles, to be distributed as follows: Placed to reserve (5 per cent.), 6,990.08 roubles; to depreciation of real estate (workshop, laboratory, etc.), 7 per cent. of original cost price (219,988.72 roubles), 15,399.21 roubles; income-tax (5½ per cent. of 117,412.29 roubles), 6,457.68 roubles; revisionary committee's remuneration, 1,000 roubles; dividend of 6 per cent. on 1,800,000 roubles, 108,000 roubles; carried forward, 1,954.61 roubles. The dividend to be payable on and after the 1st October, 1913. (The members of the Board and of the revisionary committee refrained from voting.) The meeting approved the estimate of expenses for the year 1913, amounting to 229,500 roubles, and authorised the directors to take sums on credit from Government and private institutions and from private persons, when needed, up to a sum of 1,000,000 roubles. The meeting further decided to increase the capital of the company by 1,200,000 roubles by the issue of 12,000 additional shares of a nominal value of 100 roubles each, and authorised the Board of Directors to: (*a*) decide the method of issue—of all or part—of the shares, also the terms and price of issue of the new shares, on condition that the price should not be lower than 100 roubles; (*b*) to enter into agreements with banks and other institutions and persons for the purpose of guaranteeing the new issue of shares, on conditions approved by the Board of Directors; and (*c*) to negotiate with the Government for permission to realise all the above decisions and to make in the statutes of the company all the alterations necessary to carry out the above decisions.

BALANCE SHEET, WORKING ACCOUNT AND PROFIT AND LOSS ACCOUNT for Year 1912.

BALANCE SHEET TO JANUARY 1ST, 1913.

CR.		DR.	
By Patents and Patent Rights	980,000 00	To Share Capital	1,800,000 00
Freehold Land and Buildings	336,567 73	Reserve Capital	606 21
Workshops, laboratories, machinery, plant, etc.	219,988 72	Bills Payable	463,726 74
STOCK—		Creditors	627,727 33
Apparatus, Finished and Unfinished Parts and Raw Material	368,763 03	Fine Capital	25 50
ORDERS—		PROFIT AND LOSS ACCOUNT—	
War Office and Marine	342,733 29	Profit for 1912	139,801 58
Cash in Hand	14,345 01		
Deposits as Guarantees	163,169 90		
Debtors	349,069 15		
Establishment Charges	49,694 09		
Expenses carried forward to 1913	35,000 00		
PROFIT AND LOSS ACCOUNT—			
Loss 1910 133,497 66			
„ 1911 39,058 78			
	172,556 44		
Total Roubles	3,031,887 36	Total Roubles	3,031,887 36

WORKING ACCOUNT FOR THE YEAR 1912.

Receipts	875,464 95	Expenditure	735,663 37
		Profit	139,801 58
	875,464 95		875,464 95

PROFIT AND LOSS ACCOUNT, 1912.

Profit from Completed Orders	250,189 64	General Expenses	112,653 70
Sundry Receipts	2,265 64	Profit	139,801 58
	252,455 28		252,455 28

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Wireless Telegraphy on Railways

New Stations in Canada

THE completion of the negotiations for erecting wireless stations at Le Pas and Port Nelson, two principal stations on the Hudson Bay Railway, marks another important step in the opening up

Le Pas—Port Nelson Route.

of this important trading route. For many years the question of its development has been before the Canadian public, but such schemes need careful and elaborate consideration before the work can be definitely started, as, once the hand is on the plough, there is no turning back.

The contract for the work has just been awarded to the Marconi Company of Canada by the Department of Railway and Canals of the Dominion Government. Two stations will be erected, one at each of the terminals of the proposed Hudson Bay Railway, viz.: Port Nelson on Hudson Bay, the northern terminal of the railway, and Le Pas in Manitoba, the connecting point of the new line with the Government railway system. The Canadian Government has thus shown that it fully realises the great utility to be derived from wireless telegraphy.

This is the first occasion that the assistance of wireless telegraphy has been resorted to in connection with railway construction on the North American Continent. It is, however, employed with great success in Brazil, where the Marconi Company some years ago erected two stations on behalf of the Madeira Mamore Railway Company, one at Manaos, where the local offices of the railway are situated, and the other at Porto Velho, at the head of the railway some 1,000 miles away, the only access to which point being by means of boats on the Madeira river. The results of the application of wireless on that line have proved its value in railway construction.

The object of the Hudson Bay Railway, which will be about 440 miles long, is to give the grain growers of the north-west means of cheap communication between the interior and Europe *via* Hudson Bay and the Atlantic, and the Canadian Government is doing its utmost to have the line completed before 1914.

The wireless stations will play an important part in the construction, as they are primarily intended to serve as intermediaries for the ordering and forwarding of material

A Typical River Steamer in use in the Far North.

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and labour from the base to the scene of operations, etc. The town of Port Nelson is cut off from communication with the capital during nine months in the year, but once the stations are erected the work of the officials at Ottawa and elsewhere will be greatly facilitated, as they will be able to remain in close touch with the progress of the work on the line.

The stations will be of 10 kw., the power for which will be obtained from 20 h.p. engines, and each station will have a range of 500 miles.

Loading Logs on Police Team on East Side Churchill River, Hudson Bay.

Le Pas is on the Saskatchewan river, and is distant, as the crow flies, some 410 miles from Port Nelson. This is one of the principal ports on the south-west coast of Hudson Bay. It stands at the mouth of the Nelson river, which, with its tributaries, drains the whole of southern Manitoba. The main river rises in Lake Winnipeg, but the tributaries form a network which link up a great many of the smaller lakes, and so effect a junction with the Churchill river. At present all this country is undeveloped, for its climatic conditions are unfavourable to agriculture, as it lies within the influence of the Arctic zone. But Le Pas is on the borderland between the uncultivated and the cultivated districts of this part of Canada. The Saskatchewan river runs through some of the most fertile parts of Saskatchewan. Round Alberta, for instance, there are vast corn lands and good pasturage. Now it would be quite easy to ship cargoes of wheat on the river and convey it by this means to Le Pas, thence, when the railway is completed, to Port Nelson, and from there shipments are easy to the markets of the world.

The settlement of Le Pas was formerly one of the Hudson Bay Company's posts in the north-west, but enjoys considerable historical importance as being perhaps the last civilised place from which word was received from the great explorer Franklin, of Arctic fame, when on his last trip to the north. An interesting feature of Le Pas is the little Anglican church where Franklin held Divine service.

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Port Nelson, the site of the corresponding station and the northern terminal of the railway, is destined to become a summer port of importance. The wireless station at Port Nelson will also comprise a special installation to communicate with vessels trading with that port.

Another effect of the Hudson Bay railway will be the opening up of one of the best fishing trades in the world. All the lakes of the district are full of fish, and if, as is the case on Lake Winnipeg, fishing is made to pay when the haul has to be carried a distance of 140 miles or more to rail, then the carriage of this commodity by the new route, which will reduce the distance to about 40 miles, will greatly enhance the prospects of the fishing industry, for it will bring this important item of food supply within easier reach of such big towns as Aberdeen, Prince Albert, and Battleford. Then there is a good deal of whale fishing to be had in Hudson Bay. During the summer months the Hudson Bay Company bring in many whales to their depots at Port Nelson and Port Churchill. These measure about 10 to 15 feet in length, and weigh as much as 2,000 pounds. The fish is cut up and kept to feed the dogs in the winter, while the blubber is boiled down at the factories and the hides are sent to England. Of course, one of the most important industries of North Manitoba is fur-trading and the capture of fur-bearing animals. These include the fox, beaver, otter, mink, ermine, and wolverine. At present the work is carried on by natives, Indians or Eskimos, and the method of trading between the fur companies and the natives is unique and interesting. It is carried on by means of a standard value called in most parts of the country "A Skin." There are different skins, such as "Working Skin," "Fur Skin," "Blubber Skin," "Sunday Skin," and so on. When a trapper goes to sell his goods at a store, the man in charge examines his furs, tells him he has so many "skins" worth and hands him thirty or forty small pieces of wood in lieu of cash. These he retains until he wants goods, when he returns them one by one, until he has had goods to the value of the skins he deposited. These men seldom use steel traps, but resort to the old-fashioned method of deadfalls. The Eskimos round the eastern coast of Hudson Bay are a good-natured hardy people, not particularly tall, broad-chested, with great fat greasy faces, black piercing eyes, straight black hair, and beautiful teeth. They can carry burdens of immense weight, and are fond of wrestling and other sports.

One of the most beautiful of northern phenomena, the *aurora borealis*, is particularly vivid in this district. At such times streamers of light will flash across the sky as though an invisible hand were shaking out a veil of a rainbow light over the blue immensity of the heavens. First delicate fringes of starry white appear and die, then gold, azure, amber tints, and rose follow with swift intensity, and make a panorama of fleeting loveliness. Among the natives these brilliant lights are considered to be heralds of colder weather.

It is rumoured that these stations may form the commencement of a wireless chain to extend through Northern Ontario and Quebec, and the Hudson Bay Straits, eventually linking up with the Newfoundland Government's stations on the Labrador Coast. This would be the first step towards the opening up of those territories, the development of which has hitherto been handicapped by their extreme isolation.

The Marconi Wireless Telegraph Station at the Pabst Brewery, Milwaukee, is being removed to the Broadway Building, Broadway, Constance Street. The removal has been necessitated by the large increase in business.

Mr. C. E. Hansen, of Los Angeles, when returning home from Europe on the *Mauretania*, sent a wireless message to Los Angeles ordering a motor-car for his wife. The message ran: "Have Hupp Yates runabout prepared for delivery to wife. Notify her of gift.—Hansen." The lady was in Europe when the message was sent, and the salesman immediately transmitted to her a message announcing that a motor-car awaited her arrival as a gift from her husband. The order was received by wireless and the advice was despatched in the same form. The knowledge that the transaction was carried out in such a unique way should considerably enhance the value of the gift.

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Administrative Notes

Wireless at Dar-es-Salaam

THE Board of Trade have received through the Foreign Office a copy of a despatch from His Majesty's Ambassador at Berlin stating: A wireless telegraph coastal station has been opened at Dar-es-Salaam (German East Africa) for public communication with ships at sea. The call letters are K.A.C., the normal wave-length 600 metres, and the charge for messages is 30 pf. per word without minimum charge. The range of the station is stated provisionally to be about 1,100 kilos.

* * *

A Brazilian Scheme

WE have on a previous occasion announced the issue of a decree providing for a Government organisation of wireless telegraphy throughout Brazil. The *Diario Official* now publishes further particulars regarding the scheme, which will embrace an international service of wireless telegraphy both terrestrial and trans-oceanic, a river service, a frontier service, and an inter-state service. Stations will be of both the fixed and portable types. The international stations will include one at Belem, having a range of 4,000 miles, one at Cape Santa Martha, having a similar range, and another at Rio de Janeiro, having a range of 2,000 miles. The contract for these stations has already been granted to the Marconi Company.

* * *

Australia and Weather Reports

A STATUTORY rule (No. 18 1913) has been issued by the Commonwealth of Australia relating to ocean forecasts of weather reports. It amends Statutory Rules No. 128 1911 by inserting after the regulation under the heading "Charges" the following regulation:—"Ocean forecasts sent by the Commonwealth Meteorologist will be transmitted from radio-telegraph stations owned, operated, and maintained by or on behalf of the Postmaster-General to vessels at sea, and weather reports received at such radio-telegraph stations from vessels at sea, and addressed to the Commonwealth Meteorologist, will be transmitted, on payment of the following charges:—For each communication not exceeding 20 words, 2s.; for each additional word, 1d.; plus the ordinary land line charges." This regulation is subject to amendment, but whatever charges are ultimately made, they will be paid by the Meteorological Bureau and not by the ship's station.

* * *

Revised Regulations

Two ordinances have recently been published, one affecting St. Lucia and the other Sierra Leone. The former provides that a person shall not establish any wireless telegraph station, or instal or work any apparatus for wireless telegraphy in any place or on board any ship registered in the Colony, except under and in accordance with a licence granted in that behalf by the Governor. Further, a person shall not work any apparatus for wireless telegraphy installed on any merchant ship, whether British or foreign, while that ship is in the territorial waters of the Colony, otherwise than in accordance with prescribed regulations. The Sierra Leone ordinance, which amends the "Wireless Telegraph Ordinance, 1903," provides that a person shall not work any apparatus for wireless telegraphy installed on a merchant ship, whether British or foreign, whilst that ship is in the territorial waters of the Colony, otherwise than in accordance with certain prescribed regulations. The regulations are not applicable, however, to the use of wireless telegraphy for the purpose of making or answering signals of distress.

* * *

Regulations in the Western Pacific

THE use of wireless telegraphy in certain islands in the Western Pacific was governed by the Wireless Telegraphy Regulation of 1907, which is now repealed by "The Wireless Telegraphy Regulation,

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1912 (No. 9)." Under the new regulation it is provided that it shall not be lawful for any person to establish, instal, or use any apparatus for the purpose of electrical communication by means of wireless telegraphy in any of the Protectorates, islands, or places within the jurisdiction of the High Commissioner as specified in the regulation without a licence to do so first obtained as may be prescribed. The regulation is not to apply to the islands of the Pacific Ocean known as the New Hebrides (including the Banks Islands and the Forres Islands), but is applicable to the following places:—British Solomon Islands Protectorate, Gilbert and Ellice Islands, Union (Tokelau) Islands, Phœnix Islands, Fanning Island, Washington Island, Christmas Island, Pitcairn Island, and all other islands in the Western Pacific not being within the jurisdiction of the Commonwealth of Australia or any of the States thereof, or of the Dominion of New Zealand, or of any civilised Power. Certain rules issued by the High Commissioner under the above regulation have also been made for regulating the use of wireless telegraph apparatus on merchant ships in the Western Pacific.

* * *

Training Operators in Canada

THE general shortage of telegraph operators throughout the country has been felt in the wireless telegraph service, and in the annual report of the Canadian Department of the Naval Service, Mr. C. P. Edwards, the superintendent of the Government Radio-telegraphs, states that it was found difficult at times to maintain a 24-hour watch at all the stations; in fact, so acute has this shortage become on the Pacific coast that the Department has been compelled to inaugurate a learners' division for the training of operators. The procedure adopted in this connection is as follows: An inexperienced man is attached to a station without salary until such time as he is capable of passing our "Learners' Examination," which calls for a general elementary knowledge of the apparatus and organisation, and an operating speed of 15 words a minute in the international Morse code. A learner who has successfully passed this examination is then admitted to the "Junior Operator" division at a salary of $45 per month, and is regularly attached to a station to assist in its operation. He remains in this division until he has successfully passed the "Third Operators' Examination," which calls for a thorough knowledge of the adjustment of apparatus, organisation, etc., and an operating speed of 20 words per minute; he then receives a permanent appointment.

* * *

United States Regulations

THE regulation of wireless telegraphy in the United States is being taken up by the Government with unremitting zeal. To give effect to the law which received the approval of Congress in August last, drastic regulations were made by the Department of Commerce and Labour. They have already been summarised in our columns, as have the regulations to control the amateur in the United States. Now the Navy Department has established the office of Superintendent of the Radio Service under the Bureau of Navigation. This official will be charged with matters "pertaining to the operation of radio apparatus ashore and afloat, except the technical operations hereafter assigned to the control of the Bureau of Steam Engineering." His functions are set out as under:

(1) The preparation of regulations and issue of detailed instructions for the operation of stations in accordance with military efficiency, international agreements in force, and the laws affecting the operation of naval radio stations.

(2) Control of the commercial work handled by naval radio stations, including issue of accounting and operating forms, auditing commercial accounts, traffic agreements and accounting with commercial and other Government departments involved.

(3) He shall keep the Bureau of Steam Engineering advised of all matters within his cognisance requiring work of a technical nature.

(4) He shall correspond directly within the naval service in accordance with the procedure laid down by the regulations in the case of bureaus and other offices under the Navy Department in regard to all matters in which he is authorised to take action. He shall correspond directly with private and commercial concerns upon matters of reciprocal interest relating to the commercial operation of naval radio stations in questions of interference, traffic arrangements, proposed changes of rates, and accounting.

(5) He shall submit to the Bureau of Navigation, with his recommendation, a statement of all matters that require departmental action.

(6) He shall submit such reports in regard to the naval radio establishment as may be called for by the Secretary of the Navy.

(7) His office shall be established at the radio station, Arlington, Va., of which the telegraph, radio and post office address will be Radio, Virginia. All communications for the Superintendent of Radio Service and all departmental radiograms shall be sent to that address. The necessary expense of his office will be borne by the appropriation "Equipment of vessels."

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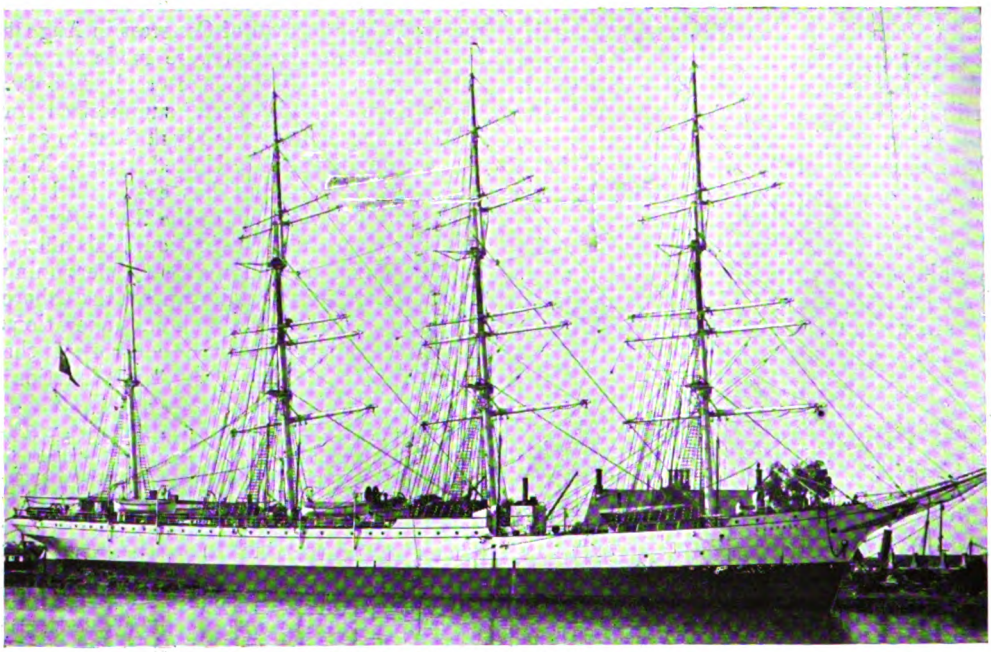
Maritime Wireless Telegraphy

THE last month has been notable for two mishaps which might have been attended with serious consequences but for the assistance rendered by wireless telegraphy.

Early in the month the s.s. *Haverford* ran ashore at Rocky Bay at the entrance to Cork Harbour. On the previous day she had started from Liverpool for Philadelphia with over 1,200 passengers on board. The news of the disaster was first received by wireless at the Admiralty Offices, Queenstown, and immediately several tenders and tug-boats were dispatched to the assistance of the *Haverford*. The dense fog made it difficult to locate the disabled vessel, but after a time this lifted and the tenders soon took off the passengers. Two Government tugs and three of the Clyde Shipping Company's tugs assisted in the work of rescue, and as soon as it became known that the *Haverford* was in danger the coastguards stationed on shore received instructions to be ready in case of an emergency, but, fortunately, their assistance was not required. Throughout the proceedings the discipline on board the *Haverford* was admirable. The shock of the impact naturally caused some alarm, but the ship's officers did everything possible to allay anxiety, and the information which was circulated to the effect that aid had been summoned by wireless and was coming largely helped to relieve anxiety.



The Training Ship "L'Avenir."

The other mishap was a collision between two British liners in a dense fog on Sunday, May 25th, sixty miles off Finisterre. The vessels were the s.s. *Tainui*, homeward bound from New Zealand, and the *Inca*. The *Inca* was seriously damaged and sent out a wireless call for help. The *Garth Castle*, journeying from Africa to Plymouth, happened to be in the vicinity and immediately answered the call. On her arrival, after consulting with the disabled vessel, it was decided that for the sake of safety all the passengers should be transferred to the *Garth Castle*.

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In the meantime the steamer *Galicia* arrived on the scene and escorted the *Tainui* to Corunna. Here the *Tainui* was docked, and it was found that her bows had been completely stove in. The *Inca* was able to sail under her own steam to Vigo, where she also was found to be considerably damaged. Her bows were stove in and her fore-peak was full of water, though the collision bulkhead was tight.

* * *

With the arrival of the training ship *L'Avenir* at Havre we have been able to ascertain some few facts and figures relating to the working of the wireless telegraph station on board this sailing ship. That the installation has been of value to the training ship there can be no doubt, and all concerned are highly satisfied with the results obtained and the services rendered.

From time to time during both the outward and homeward voyages information has appeared in the Press concerning the whereabouts of the *L'Avenir*. Such information would have been unobtainable without the mysterious aid of Marconi's invention, and needless to state it has brought much comfort to the anxious parents and relatives of those on board. Time was when the application of "wireless" to sailing vessels was considered a matter of enormous difficulty, but the installation on the Belgian training ship has successfully dispelled any doubts of success in this connection.

Let the figures speak for themselves: News was received from the long-distance Marconi station at Poldhu (Cornwall) up to a distance of 3,700 km., and the time signals from the Eiffel Tower (Paris) up to a distance of 4,260 km. Communication with other stations over distances of four, five, and six hundred miles was of frequent occurrence, while with certain stations much greater distances were covered with ease; for example, with the steamer *Oropesa* 2,022 km., the coast stations at Pernambuco 1,956 km., Olinda 2,220 km., Fernando da Noronha 2,555 km., etc.

It is also very interesting to note that the *L'Avenir* was able to maintain communication with the Australian Government naval coast station at Melbourne throughout seven entire days, *i.e.*, until the vessel was off Flinders Island (Bass Strait)—homeward bound — and that, when the *L'Avenir* was in lat. 55.58 S., long. 75.32.30 W., communication was effected over the Andes with the steamer *Mendoza*, lying at Puerto Gallegos. The wireless station on this interesting vessel is of the Marconi 1½ kw. type.

* * *

To the exceptionally long ranges covered from time to time by the Marconi Standard wireless telegraph ship stations must be added that of the *Kelvinbank*. While 1,500 miles distant from Pernambuco this vessel got into communication and remained in touch with the shore station for two days.

* * *

The Canadian Government ice-breaking steamers *Minto* and *Earl Grey* are making regular trips between Charlottestown, Prince Edward Island, and Pictou, U.S.A. These two boats are in constant communication with Cape Bear, Grindstone and Pictou, the last being the controlling station. Daily Press messages are passed between the isolated Magdalen station and Pictou. Before the Marconi stations were erected at Grindstone the natives used to place the mails in barrels and set them adrift to be picked up by passing seal steamers, as it was too dangerous for small craft to attempt venturing out into the ice fields, with the result that the inhabitants of these lonely lands were entirely cut off from communication. As it is, the ice breakers have as much as they can do to keep open a small passage clear of ice for a steamer service. On one occasion last winter the *Earl Grey* was carried ashore by pressure of the ice floes.

* * *

Bound for Cuba, one hundred and sixteen Spanish emigrants, amongst whom were a number of women and children, were rescued by wireless when the Atlantic & Eastern Steamship Company's steamer *Lugano*, bound from Liverpool to Havana, struck the Ajax reef about 40 miles from Key West. The *Lugano* struck in a heavy sea that rendered the lowering of boats a dangerous operation. When her wireless calls were received by the Key West station the tug *Nome* went out, and after two hours' smart work succeeded in transferring all passengers without loss.

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THE IMPERIAL WIRELESS SCHEME

REPORT FROM PARLIAMENTARY COMMITTEE

THE report of the Select Committee on Marconi's Wireless Telegraph Company, Ltd., Agreement was issued on Friday, June 13th.

The Committee, which was appointed on October 23rd last, and met for the first time on October 29th, originally consisted of Mr. Amery, Mr. Booth, Lord Robert Cecil, Mr. George Faber, Mr. Falconer, Mr. Gordon Harvey, Mr. Macmaster, Mr. Mooney, Mr. James Parker, Mr. Neil Primrose, Mr. William Redmond, Sir Herbert Roberts, Mr. Harold Smith, Sir Albert Spicer, and Mr. Henry Terrell. Sir Albert Spicer was appointed chairman, and on the resignation of Mr. Harold Smith and Mr. Terrell in April last, Sir Frederick Banbury and Mr. Butcher became members. Mr. Gordon Harvey subsequently resigned and was succeeded by Sir Walter Essex, but Mr. Harvey rejoined the Committee on Mr. Primrose's resignation.

The following are the terms of reference :

> To investigate the circumstances connected with the negotiation and completion of the agreement between Marconi's Wireless Telegraph Company, Ltd., Commendatore Guglielmo Marconi, and the Postmaster-General, with regard to the establishment of a chain of Imperial Wireless stations, and to report thereupon, and whether the agreement is desirable and should be approved.

The report is divided into three parts. Part I. is concerned with the rumours against Ministers, which the Committee begin by declaring " became current before the date of the acceptance of the tender." Part II. reviews the circumstances in which Sir Rufus Isaacs, Mr. Lloyd George and Lord Murray of Elibank became interested in the American Marconi Company ; and Part III. consists of a single brief paragraph as follows :

> On the whole matters relating to the conduct of Ministers which have come before the Committee, the Committee find that all the Ministers concerned have acted throughout in the sincere belief that there was nothing in their action which would in any way conflict with their duty as Ministers of the Crown.

In Part I. the Committee find that " there is no foundation for any of the charges made against these Ministers " (*i.e.*, Sir Rufus Isaacs, Mr. Lloyd George, and Mr. Herbert Samuel) either as regards the negotiation of the contract or dealings in shares of the English company. The publication of the charges in the *Outlook*, the *Eye-Witness*, the *New Witness*, the *National Review*, and the *New Age*, and references to them in the *Spectator*, are next noted, and it is declared that no evidence was submitted to justify them. The Committee also state that they cannot adopt the view that the Postmaster-General unduly pressed for the approval of the Agreement before the rising of the House on August 7th, 1912.

They state that the construction of the Imperial Chain of Wireless Telegraphy was declared by the Imperial Defence Committee to be a matter of extreme urgency ; and this was also the view of the Admiralty and the War Office. Statements to that effect were made to the Committee by representatives of both Departments in public, and their evidence was further explained and emphasised at meetings with them held in private.

Having regard to the urgency of the matter and to the fact that he regarded the Agreement as a satisfactory one, the Committee consider that the Postmaster-General was bound to do everything in his power to secure the approval of the Agreement at the earliest possible date.

This section is brought to a close by a series of conclusions which are summarised in the following paragraph :

> Your Committee further find and report that the charges made against Sir Rufus

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Isaacs, Mr. Lloyd George, and Mr. Herbert Samuel are absolutely untrue, and that the persons who are responsible for their publication had no reason to believe them to be true.

There follows this expression of opinion:

> The Committee cannot too strongly condemn the publication in such a way of unfounded charges against the honour and integrity of public men. The combined and persistent action of the journals named has given widespread currency to a slander of a particularly vile character on the Ministers against whom it was immediately directed, and on the whole public life of the nation.

Part II. of the report is devoted to the dealings of Sir Rufus Isaacs, Mr. Lloyd George and Lord Murray in the shares of the American Marconi Company, and the opinions expressed are applied to the original purchase of shares by Sir Rufus Isaacs from his brother, Mr. Harry Isaacs; the purchase of shares from Sir Rufus Isaacs by Mr. Lloyd George and Lord Murray, the subsequent independent purchase of shares by Mr. Lloyd George and Lord Murray, and the separate purchase by Lord Murray. Of these four transactions it is reported:

> The Committee find that in these transactions there is no ground for any charge of corruption or unfaithfulness to public duty, or for any reflection on the honour of any of the Ministers concerned.

The report states that in purchasing the American shares Sir Rufus Isaacs acted "in perfect good faith and with a sincere conviction that his personal interests conflicted in no wise with his public duty," and that Mr. Lloyd George and Lord Murray acted "on the faith of the assurance given to them by Sir Rufus Isaacs that the American company was in no way concerned with the English company." The Attorney-General, the Chancellor of the Exchequer, Mr. Harry Isaacs, Mr. Godfrey Isaacs, and a number of witnesses concerned in the issue of the shares of the American company, in the opinion of the Committee, "gave their evidence fully and frankly." Lord Murray's separate purchase of shares is described as being "on behalf of a political fund at his disposal."

The following are the conclusions arrived at in regard to the transactions in the American shares:

(1) They find that before any purchase was entered into by the Attorney-General he made special inquiry, and was satisfied that the American company had no interest in the agreement between the Postmaster-General and the English company, and that there was no ground on which a purchase of its shares by a British Minister would be open to objection. He informed the Chancellor of the Exchequer and Lord Murray of the result of his inquiries when offering shares to them.

(2) That the Ministers concerned, when entering into the purchases, were all *bona fide* convinced that the American company had no interest in the agreement, and that there was no ground on which the purchase of shares in the American company would be open to objection.

(3) That the American company is a company formed and registered in New York; that its organisation and operations are confined to the United States of America; that it has no interest, direct or indirect, in the proposed agreement with the British Government, and no interest, direct or indirect, in any profits which might be derived therefrom.

(4) That neither the English company nor its managing director, Mr. Godfrey Isaacs, was a party to any of the transactions in question, or in any way directly or indirectly interested in them.

(5) That in connection with the transaction between the Attorney-General and Mr. Harry Isaacs, neither the Attorney-General nor the Chancellor of the Exchequer, nor Lord Murray, received any favour, advantage, or consideration of any kind, either from the English company or from Mr. Godfrey Isaacs. The shares were acquired by the Attorney-General from his brother, Mr. Harry Isaacs, who had no connection with or interest in the English company. They were bought by the Attorney-General on April 17th, 1912, at £2 per share, which the Attorney-General had ascertained from Mr. Harry Isaacs to be the market price at the time. Other sales at or about that price (some being slightly below and some slightly above) took place on the same day, and although the price of the shares rose rapidly on the

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18th and 19th, this was owing to an exceptional rush on the part of the public to buy.

(6) That neither the Attorney-General nor the Chancellor of the Exchequer, nor Lord Murray, nor Mr. Harry Isaacs was a party to or in any way concerned in any arrangement or understanding with any other person or syndicate with regard to the purchase or sale of shares.

The debate on the report of the Committee was begun in the House of Commons on Wednesday, June 18th, and lasted two days. In the end, the following motion was carried by a unanimous House:

"That this House, after hearing the statements of the Attorney-General and the Chancellor of the Exchequer in reference to their purchase of shares in the Marconi Company of America, accepts their expressions of regret that such purchases were made, and that they were not mentioned in the debate of October 11th last; acquits them of acting otherwise than in good faith, and reprobates the charges of corruption brought against Ministers, which have been proved to be wholly false."

Marconi Station in Norway

THE Committee of the Norwegian Storthing unanimously recommends the Storthing, provided that certain modifications are obtainable, to sanction the contract made by the previous Government, subject to the Storthing's sanction, with the Marconi Company, to erect a large wireless telegraphy station near Stavangar, at a cost of 2,000,000 kroner, in connection with the wireless station erected by the Marconi Company near Boston, says Reuter. The modifications asked for have been agreed to by the Marconi Company.

Libel Action

AFTER a trial which lasted ten days Mr. Cecil Chesterton, journalist, was convicted at the Central Criminal Court, on June 7th, of publishing a defamatory libel on Mr. Godfrey Isaacs, managing director of Marconi's Wireless Telegraph Company, and was sentenced by Mr. Justice Phillimore to a fine of £100, and also to pay the costs of the prosecution.

The Judge, in passing sentence, said he entirely agreed with the verdict of the jury. It seemed to him that a good deal of the libellous articles were due to what theologians would call "invincible ignorance," and that the defendant, and possibly those behind him, were partly actuated by prejudice and partly blind to business matters. It was well that on an occasion such as that it should be publicly stated, to the terror of evildoers, what the law upon the subject was, and what the maximum of punishment that could be inflicted was, because one of the objects of all criminal proceedings was the prevention or deterring of similar matters in future. Upon each one of the five counts upon which he (Chesterton) had been convicted he might have been sent to prison for a year, and he might, in addition, be fined, as well as having to pay the costs of the prosecution. That was the maximum, and it was not the punishment he (the Judge) proposed to award. Continuing, his Lordship said, when he remembered the cruelty of some of the charges, when he remembered the sending of placards along the front of Mr. Isaacs' place of business in the Strand, it was extremely difficult to refrain from sending defendant to prison. But upon the whole he hoped that what he had said, and the opinion of the defendant's countrymen, as expressed by the jury, would be sufficient with the punishment he inflicted.

Contract News

The Italian Government have ordered three more 3-kw. sets for battleships.

* * *

The Marconi Wireless Telegraph Company have received orders from the Johnston Line to fit four of their steamers, including the *Templemore*, the *Vendamore*, and the *Quernmore*, with 1½-kw. sets.

* * *

The Isle of Man Steam Packet Company have also given orders for fitting four of their vessels with 1½-kw. sets. They are the *Ben-my-Chree*, the *Viking*, the *Empress Queen*, and the *King Orry*.

The Lantern Tower and Time Ball which has been erected on the New Seamen's Institute in New York City was dedicated on April 15th as a memorial to those who lost their lives when the *Titanic* sank on her maiden voyage.

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Instruction in Wireless Telegraphy

IV. ELECTRIC WAVES AND OSCILLATING CIRCUITS

IN the last article we showed how, in order to convey signals from one point to another by means of wireless telegraphy, it was necessary to have an apparatus for producing electric waves at one end, and an apparatus for detecting the presence of such waves at the other end.

24. **Electric Waves.**—These electric waves are produced in the æther by the inter-action of electro-magnetic lines of force and electro-static lines of force. **Electro-magnetic lines of force** were referred to in paragraph 4, and they are produced around a wire when that wire carries an electric current. **The electro-static lines of force** are produced by any body which is charged with electricity.

Consider a vertical length of wire insulated from the earth, and suppose we have means of charging and discharging it in rapid succession, first charging it positively and then negatively; whilst being charged a current of electricity will flow in the wire, and during this time electro-magnetic lines of force will be produced. The current is strong at first, then diminishes until it becomes zero at the moment the wire is fully charged; the strength of the electro-magnetic lines of force will vary in proportion. The electro-static lines of force are zero at the beginning of the charge, increase as the charge augments, and reach a maximum at the moment of full charge—that is, when the electro-magnetic lines of force are zero. On discharge the reverse action takes place. The effect of each charge and discharge produces a pulse in the æther, and if we have a succession of positive charge—discharge—negative charge—discharge, the four pulses—having regard to their direction—form a complete electric wave which starts travelling into space with the velocity of light—namely, 300,000,000 metres per second. The wire which is thus charged and discharged is known in wireless telegraphy as the aerial, and is given various shapes, as we shall see later.

A more complete explanation of this phenomenon is beyond the scope of these notes, but some further insight into the matter will be gained by considering pressure-waves in air. In Fig. 1 a long india-rubber

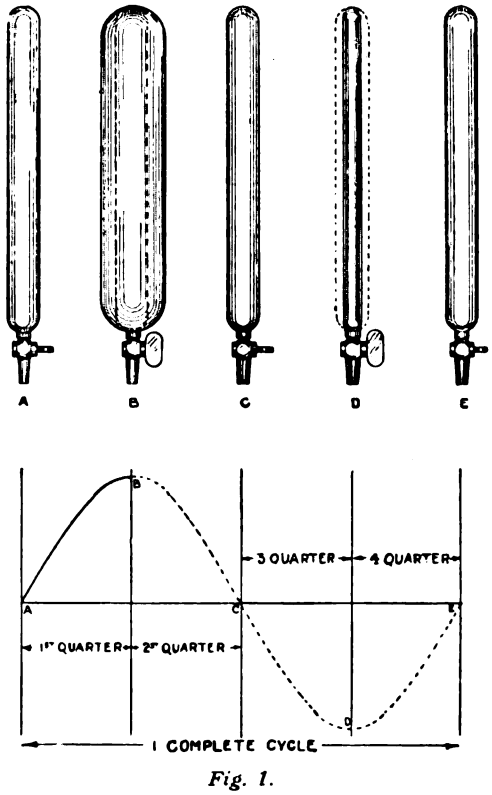

Fig. 1.

tube is indicated; it is blown out with **air**, and by means of a pipe connected to an air-compressor the pressure of the air can be varied. At the point A the air pressure in

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the tube is normal, and this corresponds to the discharged condition or earth potential of the wire. The pressure is now increased, and the tube increases in diameter, thus impressing a pressure pulse on the atmosphere. The maximum pressure is reached at the point B, and the increase of pressure can be indicated by the dotted curve from A to B on the lower part of the figure. Discharge is illustrated by the curve from B to C, at which point the air pressure in the tube returns to the normal; another pulse is thus produced on the atmosphere. Then the air pressure is still further reduced from C to D, illustrating charge in the opposite direction—*i.e.*, negative charge, and finally from D to E the tube returns to the normal conductor, illustrating the electrical discharge of the wire. Thus altogether four pulses have been impressed on the atmosphere, constituting together a complete wave. This wave travels outwards into the atmosphere—or is radiated—at the velocity of sound—namely, 1,040 feet per second. It is clear from the above that in order **to produce electric waves we must first produce an oscillating current in a circuit.**

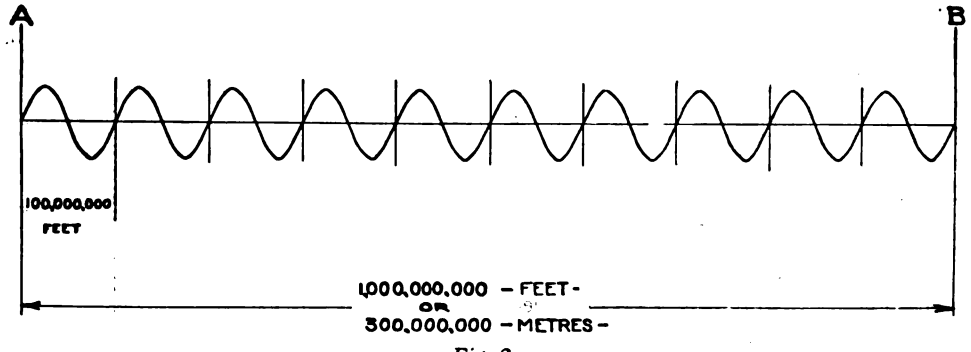

Fig. 2.

25. **Wave-Lengths.**—As will be seen by the following, the wave-length depends on the frequency of these oscillations.

In Fig. 2 the interval between the lines A and B represents the distance that a wave will travel in one second; that is to say, 300,000,000 metres. If during one second ten complete oscillations have occurred, and each oscillation produces one complete wave, the interval AB will be occupied by 10 waves. Hence the length of each wave will be one-tenth of the distance represented by AB; this is to say, the wave-length will be 30,000,000 metres. If the interval A B were occupied with one million waves, then the frequency would be one million per second, and the wave-length 300 metres.

We see, therefore, that we can vary the wave-length by varying the frequency of the oscillations in the circuit, and that **the greater the frequency of the oscillations the shorter the wave-length.**

The wave-lengths at present usually employed for the purpose of wireless telegraphy vary in length from 100 metres to 8,000 metres. Generally speaking, the larger the power of the station the longer the wave-length employed.

The wireless apparatus on ships and at the shore stations with which the ships communicate is designed to transmit wave-lengths of 300 metres and of 600 metres. Long-distance stations use wave-lengths varying from 1,000 to 8,000 metres.

The apparatus to be dealt with in these articles is limited to wave-lengths between 100 and 600 metres, and by the application of the principle involved in Fig. 2 we find that the frequency of the oscillations must lie between 3,000,000 and 500,000 per second, and the generator of these oscillations must be designed accordingly.

26. **Production of High-Frequency Oscillations.**—There are several ways of producing high-frequency oscillations. In these articles we will confine ourselves to the method known as the **"spark" method.**

If a condenser is charged and then suddenly discharged by connecting its two opposite plates through a "spark-gap," not only does the current flow from the positively charged plate to the negatively

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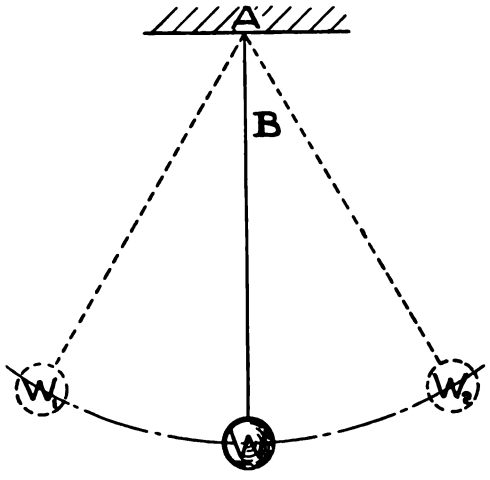

Fig. 3.

charged plate until the plates are at the same potential, but the current, so to speak, overruns itself, causing that side of the condenser which before was negatively charged to become positively charged, and *vice versa*, not, however, to the same extent, because a certain amount of the energy is frittered away by resistance. The action is then reversed and again reversed and so on, each time with less energy, until the whole of the energy originally in the condenser is absorbed. An oscillating current is therefore produced of gradually diminishing strength.

The action can be illustrated by making the experiment with the pendulum illustrated in Fig. 3, where the weight, W, is shown suspended from a fixed point, A, by a piece of string, B.

If this weight be displaced to the position shown by the dotted lines to the mark W_1 and then released, it will not immediately take up the position W, but will swing backwards and forwards between the positions W_1 and W_2, and it only comes to rest at the position W after some considerable time.

In this case the number of swings which take place in a second—that is, the frequency—can only be varied by varying the length of the string. A similar experiment can be made with a vibrator, shown in Fig. 4, in which there is a flat steel spring, B, fixed firmly at the point A, and carrying a weight, W, at its other or free end.

If the weight be displaced and released it will swing or "oscillate" between the positions W_1 and W_2.

In this case the number of swings per second will depend upon the length of the spring, B, and also upon the weight, W, and we can therefore vary the frequency either by varying the length of the spring or the weight, or by varying both. It will be found that the longer the spring the less the number of swings per second, and also the greater the weight the less number of swings per second. The distance between the position W_1 and the position W_2 is called the maximum amplitude of the swing, and generally the distance between successive positions, such as W_3, W_4 in Fig. 4, is called the amplitude.

Owing to friction of the air the amplitude will start at a maximum and gradually diminish until the spring comes to rest in its normal position, and the rate at which the swing decreases is called the **Decrement.** The frequency will, however, remain constant quite independently of the amplitude; that is to say, in Fig. 4, the time taken for the weight to travel from the position W_1 to W_2 and back again will be exactly the same as the time it takes to travel from the position W_3 and W_4 and back again.

To summarise, two matters have to be considered in connection with such a vibrator, viz.:

1. The frequency—depending upon the elasticity of the spring, which can be varied by altering its length or its thickness, and upon the weight.

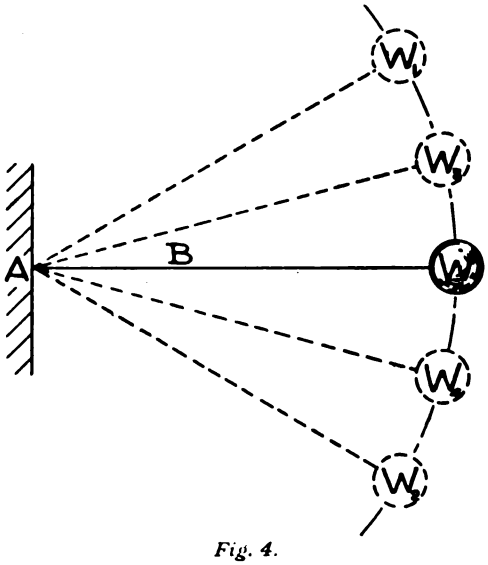

Fig. 4.

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2. The decrement—depending only upon the resistance to motion.

27. **Oscillating Circuits.** — In the first article we stated that an electrical circuit had three properties — viz., inductance, capacity, and resistance; and if we compare the oscillating circuit, described in paragraph 26, with the vibrator, we may say that the inductance corresponds to the spring, the capacity to the weight, and the resistance to the resistance to motion.

If we make a simple electrical circuit, as shown in Fig. 5, consisting of a condenser, A, connected to an inductance, B, and a resistance, C, such a circuit can be made to vibrate or "oscillate" electrically. Moreover, it will oscillate with a definite frequency, which will depend upon the value of the condenser, A, and of the inductance, B. Also the oscillations will gradually die out, and the rate at which they do so depends upon the value of the resistance, C.

It will be found that as we increase either the value of the capacity or of the inductance of the circuit so do we decrease the frequency of the circuit, but not proportionately. It can be shown by a mathematical proof (if the resistance is small enough) that the frequency is

$$\frac{1}{6{\cdot}28\sqrt{\text{inductance} \times \text{capacity}}}.$$

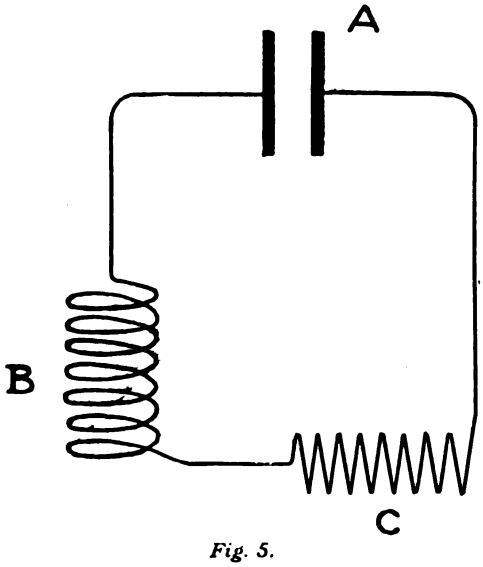

Fig. 5.

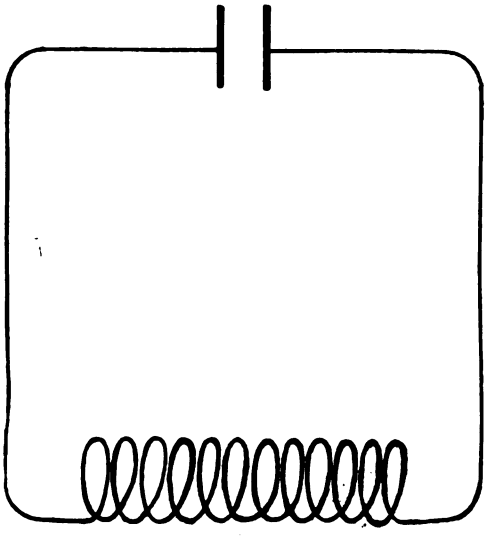

Fig. 6.

If, however, the resistance is greater than a certain amount there will be no oscillations. In the circuits we are considering the resistance is small, and then the resistance has no effect on the frequency, but only on the decrement.

Resistance is an undesirable property, as it absorbs power. In every oscillating circuit, therefore, the resistance should be reduced to a minimum quantity, which is effected by increasing the size of the conductor and reducing its length as much as possible; there must be, however, always a certain amount of resistance.

A simple oscillating circuit is therefore usually shown diagrammatically as having only inductance and capacity, as shown in Fig. 6, it being understood that the resistance is kept as small as possible.

Fig. 5 represents an aerial wire connected to a spark-gap, which in turn is connected to earth; the aerial acts as one side of the condenser, and the earth acts as the other; the wires forming the aerial also supply the inductance. We thus have the combination we require to produce an oscillating circuit, in conjunction with an aerial which will convert the successive charges and discharges into electric waves, as we have already explained.

Such a circuit is called an **open oscillating circuit,** and it has also the property that

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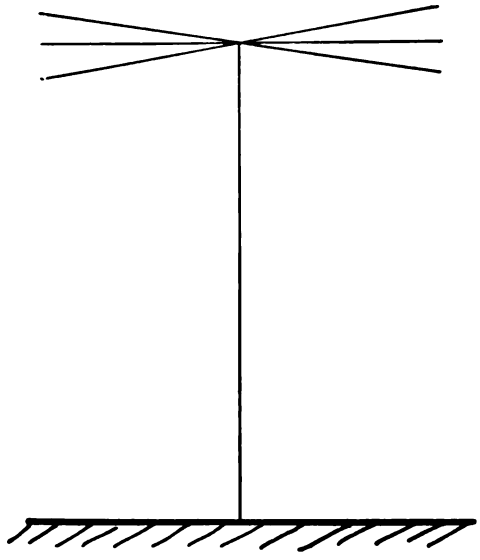

Fig. 7.

electric waves passing across it will induce oscillatory currents in it, and thus it can be used for receiving wireless messages.

Closed oscillating circuits can also be formed, such as those shown in Figs. 6 and 7, and they have this important property that they do not radiate electric waves to any appreciable extent.

28. **Variation of Wave-Length.** — As already explained, the frequency of the aerial oscillating circuits must be adjusted so that the wave-length of the emitted electric waves is that desired, and this can be done by altering either the capacity or the inductance, or both.

The capacity of an aerial can be increased by increasing the number of the wires forming it, and the inductance of the aerial can be increased by lengthening the wires. Thus the larger the aerial the less the frequency, and therefore the longer the length of the electric waves.

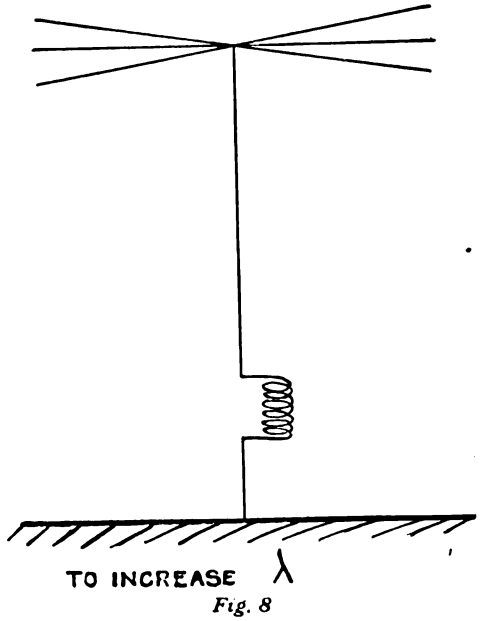

Fig. 8

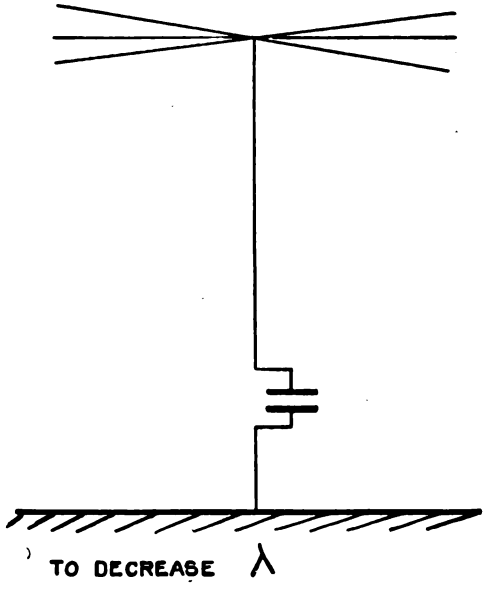

Fig. 9

It would be a tedious and, in fact, impracticable operation to alter the aerial every time it was required to alter the wave-length, and therefore another method is adopted, based on the addition to the aerial circuit of an inductance or of a condenser.

If we connect an inductance in series with another inductance the total inductance is increased. Therefore, if we insert an inductance, λ, as shown in Fig. 8, in series with the aerial, **we have increased the total inductance of the circuit, and thereby increased the wave-length**, and this method is adopted when it is desired to increase the wave-length to a value greater than the natural wave-length of the aerial.

This added inductance tends to make the open oscillating circuit of the aerial into a

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closed oscillating circuit; the more inductance we add the nearer do we approach a closed oscillating circuit. As already stated, a closed oscillating circuit does not radiate to any appreciable extent; we therefore reduce the radiating properties of the aerial by adding inductance. There is, therefore, a limit to the amount of inductance that can be so inserted into the aerial circuit.

In practice it is found that the natural wave-length of an aerial can be about doubled without seriously interfering with the radiation; thus we have a simple means of controlling the wave-length.

The frequency of the oscillating circuit can be increased by reducing the capacity, as already pointed out, and we thus have a means of reducing the wave-length. If we place a condenser in series with another condenser, the total capacity instead of being increased, as might at first be imagined, is reduced. Therefore, if we insert a condenser, as shown in Fig. 9, in series with the aerial, the total capacity is reduced and the wave-length is also reduced.

The amount by which we decrease the capacity depends upon the capacity of the condenser which is inserted in series, and it it important to remember that the greater the capacity which is inserted in series with another capacity, the less is the reduction

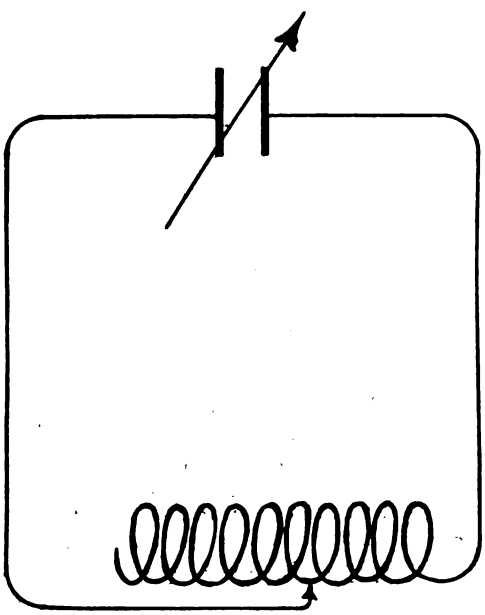

Fig. 10.

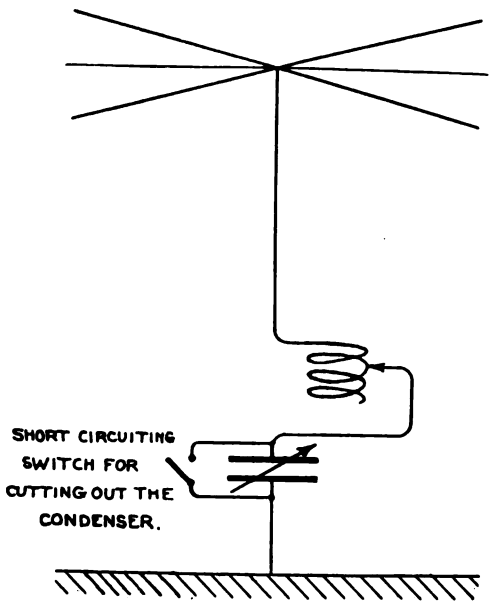

Fig. 11.

of the original capacity; that is to say, by inserting a small capacity in series with the aerial we reduce the wave-length of that aerial far more than by inserting a large capacity in series with it, because the combined capacity is always less than the smaller of the two.

Similarly, as in the case of inductance, the insertion of a capacity in series with the aerial reduces the radiation of the aerial, and as a practical matter it is found that the natural wave-length of the aerial can be halved by this means. It will be seen, therefore, that the length of the electric waves emitted by the aerial can be varied from one-half to double the natural wave-length of the aerial by adding a condenser or an inductance to the circuit.

Fig. 10 shows an aerial with an adjustable condenser and an adjustable inductance connected to it. The frequency can be changed, and such an aerial is capable of emitting waves of different lengths within the practical limits mentioned above.

Fig. 11 shows a closed oscillating circuit in which both the condenser and the inductance can be varied, and is therefore an oscillating circuit with an adjustable frequency. The use of such a circuit in conjunction with an aerial oscillating circuit will be described in the next article.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire.*

GWEN THRALE.—*Charles Summers' fiancée, a bright intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society.*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly belonging to the leisured and wealthy class with no particular aim in life.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip.*

Charles Summers, the only son of the Vicar of Sotheby, is an engineer and inventor. His peculiarities arouse comment among the villagers, and his workshop is the subject of so much curious speculation that Doss and Suk, two itinerant pedlars, make it their business to discover its secrets. They are, however, strictly warned off the premises. The only person "in the know" is Gwen Thrale, Summers' fiancée, a high-spirited girl, who often looks in to "help" him in his work. Gwen is no unsophisticated Miss; she has been a probationer at the Slade School, and is secretly a member of the Fabian Society, and in this connection has become acquainted with two foreigners, M. Dupont and Herr Beulner, who are discovered to be visiting the neighbourhood. These two men are apparently members of the leisured class and can afford to tour about the country in a grey motor. On one occasion the motor comes to grief just as they are passing Miss Thrale and her fiancée, who immediately go to their assistance. In this way they get an introduction to the inventor, and then by means of the Fabian Society they achieve closer acquaintance, and finally obtain Charles' invitation, through his fiancée, to visit him in his workshop. In the meantime they have chanced upon Doss and Suk, and through them have discovered a good deal about the inner workings of Summers' wireless airship. But for some reason or other they are determined to know even more, and lay their plans accordingly.

CHAPTER IV. (*continued*).

A FEW moments passed, and then Charles hurried in and leaned over her shoulder.

"Now turn round that switch till it comes over to that knob. Now you are in tune. Now press that brass dot—don't forget to watch how the thing's going from the telescope.

"There, hasn't her prow dropped? Yes, but she's going straight, and she'll be into the stable in a minute if you don't look out. Look, there's that button to touch—quick! Oh, that's better, she just rising above the roof. I made sure the poor little toy was gone for good then."

"But, Charles, she's going in a straight line. She'll be out of sight in a minute. Can't you make it go into a circle?"

"Yes; touch those three ebony keys marked 1, 2, 3; they'll bring her round. Don't touch them too sharply. It makes her jerk, and that doesn't do the machinery any good."

"Now what am I to do to make her do a figure of eight?"

"Why, press that lever, and then touch those three keys again. There, now, isn't that all right? I can't see; you must see how she's going."

"Yes; she's all right, but she's heeling so. What is to steady her?"

"Well, make the circles wider. See—play on the other notes on the higher keyboard, and now push in that little nickel point that regulates the engines. Now, do you want to send an electric flash?"

"Yes; so long as it doesn't hurt the machine."

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"Well, when I say Go, release that lever, and then jerk it back. There you are, that's all right. How did it go?"

"Why, it sent out a terrific flame. But, I say, I don't think it would be very long before I could pick this up. You'll let me have a practice or two, won't you, Charles, dear? It would be so lovely if I could do it all by myself. Do show me how to, and give me a lesson or two. Can't I come next Saturday? I'll be very quiet and won't disturb you a little bit. Really I'll learn quite quickly."

With her head looking up at him, and those grey eyes adding emphasis to her petition, what could Charles do but say "Yes."

. . . . .

But the trial trip of the miniature Summers' airship had been witnessed by other interested spectators besides the little group on the Vicarage lawn. Doss and Suk were trudging through the heather on their way across the downs to Chittingham when they first sighted the phenomenon. Breathlessly they watched its evolutions as it rode like an unquiet spirit over the dark masses of the pine trees. Then they caught sight of the fire balloon rising from the depths of the valley and slowly sailing towards them, while the unearthly hunter gave chase. Presently came the flash which made their old eyes nearly start out of their heads, as the fact was literally burned into their dull intelligence that they had witnessed something beyond the ordinary, something wonderful, something terrible. In a fuddled way they realised that some unknown force had been let loose that evening, some enemy was stalking through the night air, but what the exact interpretation of the phenomenon might be it was beyond them to discover. None the less their old bones were shaken by the apparition, and Suk's long-drawn exclamation, half groan, half sigh, expressed the feelings of them both.

But it was Saturday night, a time when there was always good trade to be done in the highways of Chittingham, for then the week's work was over and the lads would be out walking with sweethearts and the wage-money would still be heavy in their pockets. Such propitious seasons are not to be neglected, even by pedlars, so with a "Thee be losing time, Suk," Doss reluctantly turned on his heel and made his way down the hill. Then Suk made haste to shuffle after him, but even more reluctantly, for every now and then he loitered to see if anything more was to be seen. But the airship was the only thing now visible, and as it continued its solitary flight it might have been some exultant aerial conqueror that had slain his rivals, and now, in splendid isolation, was revisiting the scene of his conquests in all the insolence of his triumph.

But as the darkness drew on and the way became steeper the two old people were obliged to give all their attention to choosing their path, and presently the pine trees entirely shut out the sky. After a time they emerged on the high road, but had only gone a short distance along its dusky margin when a large grey car slid silently by, the two great goggle lamps flooding the whitened hedges with light. In the glow Doss and Suk were silhouetted sharply against the hedge, their eyes blinking as they supported each other, for they were made giddy by the brilliant rays. Scarcely had the motor passed when it stopped, as though waiting for them to catch it up. They shuffled along, prepared to whine a pitiful tale on the offchance of a few coppers, but their intentions were cut short. The car was indeed waiting for them, and one of the occupants was half leaning over the side. He was the younger of the two, and as they came up he held out a silver coin, which Doss took with unbecoming alacrity. Then he spoke.

"Can you tell us where we are? Surely we ought to be quite close to Sotheby?"

"Thee be roight, sur. It be scarce ten minits' walk even for the laikes of a poor old body like me, and with that great car ye'll reach it slithy as blue lightning."

"Good; but we shall have to put up for the night. Where's the best inn?"

"The Granby Hotel does for the gran' gentry, though it's 'Chittingham Arms' as takes in the most of us honest country folk, who be too pur fer feather beds."

"Well, then, we'll try and find the Granby. It's down this way, I suppose?"

Suk nodded.

"But there's one thing more we want to know. Whose is that airship which was just now making big circles in the sky above the pine trees over there?"

"I dunno; but it's laikely be some of

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Maister Summers' capers. He be the Vicar's son, and they say as how he's a cracked 'un, but I don't believe no cracked 'un could set that turble thing sailing through the air like some great Devil's Bird, and when the lightning flashes thro' the creetur's eyes it be that unearthy it do make me old bones creep. Us folk don't want no more parson's sons, or cracked 'uns, if they be all laike Maister Summers."

"What does this Master Summers do? Where does he live?"

"Oh, he lives at the Vicarage with's feyther, but 'e ha' a quare little shanty all on's own in the garden where he do sit time an' times rubbing 'is 'ands through his long 'air—an' 'e's as shock as me ole beesom—or else 'e's messing about with tools as ye never seen the like of."

The airship had not yet finished its trial trip, for Gwen was "practising," and, at this moment, she switched on the final flash from the heat antennæ. The result was a brilliant lighting up of the sky, which the increasing darkness intensified, and the effect was not lost on the talkers in the lane.

"But there's another white flash. I wonder what's happened now!"

"Some more Devil's tricks, you be bound. A turble sight too much 'appens when those white lightings coom. The ugly craitur chases any manner o' thing that flies near it. It's scarce twenty minits agone since it caught a balloon and burned it to nothing before you could draw a breath out o' your body. It's noo doot it caught another just then, for it's only when it's near to catching 'em that a glar light appears."

"So that's what the machine does, then. It chases anything that comes near it. But how can that be done, I should like to know?"

"Ah, well, how's honest folk to find it out? Lord's mercy! we do na want all the parish a doin' o' Satan's work an' sending up sooch like flying things to destroy harmless folks' peace o' mind. One's enough—And I heer's as how he tinkers about with lots on other queer tack. I've heerd, too, as how he knows all about that wireless which them larned folk an' the noospapers talk about, though I've never struck on any that knows aught to tell a body. I'd be swoorne there beant nothing in it, and them science-larnd men talk aboot it to make themsel's look fine, or else it's a rale gran' secret that they dursn't tell on."

"Then Mr. Summers has got a long flagstaff set up in the garden?"

"Na, there beant no flagstaff, but thar be a long pole sticking up from the roof of the shed with wires stretched across to another pole, as though 'e be thinking of making telegraph lines, but 'e ain't got no forrader. There they be slack as when 'e first put them up. It must be nigh some year ago. But 'e's got something wonnerfu strange yere in that room of 'is, and 'e makes wonnerfu strange noises when 'e taps on 'is table. I'm sure, 'e beant so cracked as they ses 'e be. I'd lay my old pipe 'e's a limb of Ole Nic'."

Other questions asked by the inquisitive stranger failed to elicit further information, so putting his hand in his pocket—a movement Suk watched curiously from the corner of her eye—he ended the interview by saying: "Well, all you've told us about Mr. Summers has been very interesting; but I think these experiments are dangerous to the public, and the authorities should be told. But though you have told us a great deal—and here's something for your pains—it wouldn't be quite sufficient to make a case of, so if you keep quiet and can find out anything more about these experiments we'll pay you well for your help."

"Na, na; ye'll be bringing on us to the coorts, I can see.'

"No, my good woman, we should do nothing of the kind. There'd be no need to say how we got our information, so you needn't worry about that. I don't know your name now, and I need never know your name, so your part in the affair would never be known. But some more news might be useful, so if you can get us any we'll pay you well for it. Five shillings each time you can tell us something fresh."

"But where shall we find ye, sir?"

"Oh, there'll be no difficulty about that. You'll often see us driving about in these parts; we shall be down nearly every week-end to Chittingham, and we'll make a point of coming round this way sometimes, so if you keep a look-out you will be able to come across us easily enough."

"Veery good, sur; an' thank ye; an' if old Suk can't get noos, whey then nobody in Chittingham can get it for ye. I'll find

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ye out when I larn anything more sartin' about Master Summers. Thank you kindly, sur. Gu'ni."

With that the two old vagrants started towards the village, while the grey car and its occupants continued its way, and was soon swallowed up in a cloud of dust. For a long time Suk continued to rub the two half-crowns which had been given her between the horny palms of her hands. Such a sum to her was a small fortune.

"Them folk be real anxious fur noos," she remarked as she tossed them on the ground to see if they rang true. "An' demme if old Suk cannot geet 'em sum moore," she added as an afterthought as she picked them up and put them in her wallet. She still owed the Vicarage people, and Charles Summers in particular, a grudge for her rough treatment on the occasion of her last visit. With that disproportionate view, which so often comes of solitary reflection, she had magnified a little roughness into a great insult, and the conversation with the occupants of the grey motor-car had added fuel to the flame. It made the old indignation smart intolerably now that she felt she had the opportunity to pay off those old scores. It would not be her fault anyhow if a few more half-crowns did not come her way.

CHAPTER V.

LIMING THE TWIG.

The lecture room in Kensington was ready for the evening's entertainment. The rows of chairs, like a gaunt and imposing array of ribs, were not yet clothed with humanity, and the speaker's platform looked dreary and discomfited with only a red baize tablecloth and the glass and water-bottle to adorn its vacancy. But while there was yet a good half-hour before the lecture opened, enthusiasts began to arrive, mostly young women in skimpy gowns, with lean collarless necks stretched out in æsthetic and revolutionary vehemence. After a time there entered a typical Bohemian in slouch hat and his Inverness cape escorting two companions, the one short and dark of the towselled hair, the other clean, neat, spruce, well liking. The Bohemian motioned his friends to make their way along the gangway while he talked to an attendant, and as they sauntered along, choosing what seemed to them a likely position, they were easily recognisable as the occupants of the grey motor. Evidently they were expecting great things, for Dupont was nervous, and showed it by tugging his moustache, while the pink and white complexion of Beulner was more flushed than ordinarily. With extreme care they settled themselves in their seats, and then started a conversation. This must have been of some interest, for they leaned closer and closer towards one another till at last their heads almost touched. Dupont was certainly engrossed in his topic, for his hands began to demonstrate his theme. They closed together, they were parted, occasionally his right hand would rest on Beulner's shoulder. Then the plump, short fingers would open and close, sometimes they would seem to be struggling with a difficulty, then they would be smoothed out, as if it had been overcome. Occasionally both hands would be clenched, or he would grip them together as he bent forward. All this time his excitement grew till at last he gave a chuckle and exclaimed loudly, "*Et nous attrapons l'oiseau!*" while he rubbed his palms together as if in foretaste of a triumph. Beulner seemed hard to convince, but after a time he apparently gained fresh insight into the older man's argument, for he, too, became excited. But his friend's exclamation, however, caused him to realise his surroundings, for as he glanced round to see the Bohemian standing beside him, a shadow of annoyance or confusion passed over his face. It was so momentary, however, that neither of his companions observed it, and the small talk, interpolated by the intruder, enabled him to forget his self-consciousness.

"Well, my friends, and so you catch your hare, then cook him. That's very nice, but I should like to know what it was all about: for though I am a Fabian, I don't believe in social anarchy, and you look as though you intend to overthrow thrones and potentates."

Dupont immediately set himself to dispel such an illusion.

"Oh there, you artists, your susceptibilities are so *fines*; and, indeed, all you English imagine such horrible things. Why only yesterday a funny old josser, you call him, at Hampton Court, was telling me all about the spooks there. He was ver-ry much in earnest, for his eyes *faisaient des grands Oes*,

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and though he tried to laugh when he told me the tale, I saw the terror, for the ghost of poor Katrine was upon him like an evil eye. So then you. You think me anarchist; me the most respectable man of society, me who have more to lose by Socialism than the most poor have to gain. *Oh comme vous etes drôles!* Come and sit down and I will tell you all about a little idea we have, the most charming in the world. You say we shall meet Miss Thrale. Well, we owe her a little acknowledgment for much kindness. Only the other day herself and her fiancé did help us when we were in much trouble. Do you know I told you all about how our motor-car tumbled into a ditch, and she and, I forget his name, helped us. Therefore, why not let us give a leetle dinner in her honour after the lecture. You can preside, you can be host. We will pay, and it will give us the opportunity to give her proper thanks when we ask her health over a glass of wine. Beulner agrees very much with this proposal. Don't you think it's a good idea, and if only we can get Miss Thrale to accept we shall be most happy. Do you persuade her, or, if she will not come alone, you will know some lady perhaps who can come with her. See, *mon ami.*"

Mon ami considered the question, and thought the idea not bad. Miss Thrale was a favourite and good company, besides there would be a chance of asking another friend ("Amie") or two, and of making a little impromptu festival, such as the soul of the artist loves. He, therefore, commended the idea, but emphasised the necessity of finding one or two ladies to accompany Miss Thrale. In the meantime the empty chairs of the auditorium had gradually filled, and the "early" enthusiasts were augmented by the "interested," and these were being quickly supplemented with the "curious" and the "general" audience. In fact, it only wanted five minutes to the scheduled time, when the *élite*, the *cognoscenti*, of the company were due to take their seats on the platform. The eyes of the three men began to wander over the audience, the Bohemian to find out the other two who were to make up the dinner party, Beulner and Dupont to discover *la belle samaritaine*, as the latter had elegantly described her. Just as the hands were pointing to eight o'clock she appeared with a companion, and began to look hastily round for a vacant seat. Dupont was prepared for this, and hastened forward to meet her with that exquisite bow of a Frenchman, which is a combination of homage, flattery and audacity. He told her that he had forestalled her coming, and had been bold enough to reserve a seat near his party. Would she occupy them. There were two if she cared, and he would be most happy. She would be able to see and hear the lecturer to the best advantage. Gwen, who had guessed how things would be, but had hoped that fortune might have ruled otherwise, could not very well do anything else but accept. They were taken to the seats reserved for them, and embarrassing preliminaries were cut short by the opening of the debate. Then any misgivings she might have had were overcome in the interest of the subject under discussion. The arguments of the speakers were brilliant and enthusiastic, for the Fabians know how to organise debates. Fervour is not wanting at their meetings, and the whole atmosphere was soon electrified as only whole-hearted zeal can quicken politics and economics into life. Gwen felt it. It stirred her blood. It kindled the spirit of adventure which was easily awakened in her. Her sparkling eyes and flushed face showed her excitement, and before the lecture was at an end a whole whirlwind of excitement possessed her. All this was not lost upon Dupont. With an insight, which is not uncommon in Frenchmen, he gauged her disposition, and knew exactly how best to make his proposition.

"Oh, Miss Thrale, this evening has been magnificent. I feel that I want to be a Socialist, a martyr, a hero, a propagandist; and I can be none of these. All that is left for me is to put on my overcoat and to chase an omnibus. But I don't want to do these things. There is no fun. It has nothing of *la joie de vivre*. But I know what we can do. Permit us to make a little dinner in honour of the *affaire* of your recent kindness. My friend here knows all the ropes. Will you be my guest for just one little hour, and will your kind companion accompany us, while my friend has another lady whom he wishes to come, too, so that we can all finish up in a proper way so pleasant an evening?"

Of course Gwen had excuses to make. She must get home, and if she were any later

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the 'buses to Bayswater were few and far between.

" Oh, but Miss Thrale, dere is a taxi, which will take you to the door in a *clin d'œil*. Then the 'buses at Bayswater could go hang, and your friends will still be surprised to see you so soon. We will not be very long. We will be as short as you like, but permit us to pay you this compliment which we suggest and we shall both be infinitely happy for the honour."

What was there to say? Gwen's companion was agreeable to the enterprise, the "*amie*" of the artist had been brought up and introduced, and was already drawing on her gloves in preparation for a speedy departure. Without making a scene Gwen could not very well get out of it, besides in her heart of hearts, although entirely against the dictates of reason, she quite agreed with Dupont that it would be a good ending to the evening. She allowed herself to be persuaded, and so fate brought another adventure to the adventurous.

The question of where to dine introduced a vivacious discussion amongst the party. Finally the Coventry was decided upon. Then how to get there. There was only one possible solution to this question. A taxi cab. But there were too many for one taxi cab. Two taxi cabs would make the party three in each—most unsatisfactory. The thing was to be done in style if done at all, so a third was chartered, and the little party paired off into the several vehicles. In spite of Gwen's instinct to avoid Dupont for a partner, and certainly without any marked effort on his part to secure the result, she ultimately found herself seated by him in the taxi, which was skimming along the wide streets of the metropolis. She was dissatisfied with the situation, or, rather, she felt disinclined to throw herself into an adventure which would, under ordinary circumstances, have been very much to her liking, but she was, above everything, a creature of circumstances and quickly influenced by her surroundings, so that before she was well aware of it she was already reconciling herself to the inevitable, and that was but a short step to becoming interested and vivacious once more. Besides, Dupont was irresistible. He was a man of culture, of infinite worldly wisdom, a keen observer of human nature, and, above all, knew how to make himself fascinating. He knew exactly how to trade on his foreign origin and accent. He knew, too, how to draw his companion, and combined with this he knew how to listen without saying a word, merely expressing his sympathy by little gestures, a raising of the eyebrows, a motion of the hand, even the attitude he assumed would emphasise his interestedness, and there are few people who are proof against a good listener. At present, however, he was reconnoitring; groping, as he would say, *à tatons*; carefully avoiding any line of conversation that would be likely to divulge the ultimate issue of the conversation, yet, like a skilful general, he was directing the flying columns of his speech. He wanted to avoid the main action for the present, as there was a chance of the conversation being broken off at an untimely moment, when it would be difficult to renew the attack without his purpose being observed. He therefore kept his subject well within bounds, and contented himself with by-play, but at the same time he lost no opportunity of opening up avenues of approach, so that when the exact moment arrived he might bring the whole battery of his eloquence to assault the secret citadel and break down the barriers of Gwen's reserve. Like a Wellington in this conversationary encounter he kept his watch in his hand, timing the moment for commencing preliminaries. Gwen by this time was talking fluently. Together they discussed the merits and demerits of Sotheby and the beauty of the surrounding neighbourhood. Dupont graphically described the Granby Hotel, he imitated the buxom housekeeper who would drawl when she spoke of the "gentry" and whose one purpose in life seemed to be the destruction of flies in their myriads and the consequent strategic disposition of fly papers in the most unexpected places throughout the Granby Hotel. Gwen laughed heartily at his vivacious descriptions, and Dupont noting that Hyde Park Corner was reached and that they would not be long spinning down Regent Street, enlarged on the subject by giving his hearer a description of herself as he had received it from the mouth of Mrs. Bundross.

(*To be continued.*)

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Our Bookshelf

"LA TÉLÉGRAPHIE SANS FIL," par Leon Van Aerschodt, attaché a la bibliotheque de l'Observatoire royal de Belgique. (Brussels: Veuve Ferd. Larcier, editeur. 0.50 fr.)

This small volume comprises only 27 pages, but by judicious selection the author has given an interesting account of the development of wireless telegraphy. His work differs from others dealing with the subject, inasmuch as it is not a practical treatise, nor does it describe systems or apparatus. Mr. Aerschodt has given a review of a remarkable discovery in a style which is at once interesting and instructive.

* * *

"THE SEA MONARCH," by Percy .F Westerman. (London: Adam & Charles Black. 3s. 6d.)

Mr. Westerman has set himself a task which is beyond his power. His aim has been to write a story of thrilling adventure for boys, introducing all the latest novelties of sea craft and armament, to say nothing of anticipating the future, and inventing a good deal of complicated machinery, which, if it confuses the mind of the reader, has at least the merit of bringing about more than one dramatic situation in the course of the story. The hero, Gerald Tregarthen, is a young naval officer on board a mysterious Super-Dreadnought, the *Olive Branch*, which is owned and commanded by a certain Captain Brookes. Captain Brookes maintains that he has a special mission—to eliminate warfare. By means of a "potential electric fluid" he is able instantly to destroy a fleet, and his idea is to exterminate the ships of all nations who persist in attempting to settle their differences by the arbitrament of the sword. In his efforts in this direction Captain Brookes brings his ship through several vivid, exciting scenes. He is proclaimed outlaw by the Great Powers, but evades capture in a most masterly way. Finally the *Olive Branch* arrives in the nick of time to save the British fleet from disaster at the hands of a powerful European alliance and turn defeat into a glorious and final victory. Throughout the tale wireless telegraphy and telephony play a conspicuous part. But the whole story is unconvincing. Even the school-boy will recognise that the author has allowed himself to overlap the bounds of possibility, and has made too large a demand on the credulity of his readers. It is a pity, for Mr. Westerman has a pleasant style and writes briskly, while there is no gainsaying that he has plenty of imaginative power and his knowledge of naval affairs is considerable. If he were to write another book and exercise more control of his pen, we feel sure that the effort would repay him, for the number of good writers for boys is lamentably few. As regards production, the book is wonderful value. There are 227 pages of clear readable type. There are 12 admirably drawn illustrations by E. S. Hodgson, and the whole is bound in a strong, sensible cover. But a word should be said for the cover paper, which displays a brilliantly executed scene of a naval battle.

* * *

Books to build a battleship. It sounds as extravagant as "new lamps for old." But let us be done with dark sayings and set the facts of the case as concisely as may be. Early last year the Swedish Government decided that it was impossible to carry out a plan of warship construction which had previously been arranged, and was to include the completing of a warship belonging to the "F" type. This would have given the Swedish navy a vessel larger than any she at present possesses, and the necessary curtailment of armament expense roused the whole of Sweden to an unwonted pitch of patriotic fervour. Meetings were held all over the country, and it was decided practically unanimously that whatever happened Sweden was not to be disappointed of her warship. A national subscription was started to raise the sum necessary for its construction, and

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this was no light task, for the estimate put down the cost at about 12,000,000 krone. But Sweden was not to be put off in her ambition. A hundred expedients were devised for raising the necessary money, and the enthusiastic response to the call on the nation's private purse resulted in a subscription list which totalled more than 16,000,000 krone. or 4,000,000 krone above the amount actually required for the specific purpose of the fund. Such a sum works out at about 3s. 6d. per head of the population, a remarkable testimony to the patriotism of the Swedish people. Among the schemes devised for raising funds was a book auction. It took place in the chief hall of the Grand Hotel in Stockholm, and was itself an event of much importance in the annals of literature. All the books were provided by notable authors, who themselves wrote inscriptions, or added autographs to the volumes, so that it was a unique collection which was put up for auction in March last year before an assembly which included all the best-known members of Swedish society.

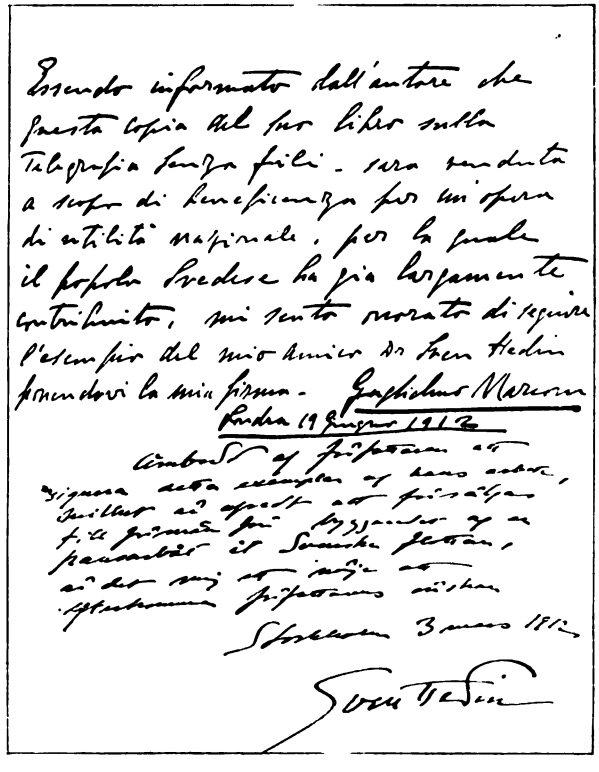
The book which brought the highest price was one on "Wireless Telegraphy," by Mr. Thor Thörnblad, and 1,300 krone, or about £72, was the sum paid by the purchaser, Countess Wilhelmine von Hallwyl, who has graciously permitted us to reproduce a facsimile of the flyleaf which bears the inscriptions of Mr. Marconi and Dr. Sven Hedin, besides that of the author. The work is still in publication at the price of £1, and contains some 900 printed pages.

Dr. Sven Hedin first contributed his inscription. It is in Swedish, of which the following is a somewhat free translation:

"Asked by the author to sign this copy of his book, which is intended to be sold for the benefit of a fund to build a warship for the Swedish navy, it is a great pleasure to me to comply with the author's request.

"Stockholm, the 3rd of March, 1912.

"SVEN HEDIN."



Mr. Marconi, following the lead of the brilliant explorer, also added a brief message before signing his name. It is in Italian and reads:

"I have been informed by the author of this work as to the purpose for which this copy of his book on Wireless Telegraphy will be sold—that is to say, in order to augment the funds, contributed so generously by the public of Sweden, for carrying out a work of national importance. I have therefore the honour to follow the example of my friend Dr. Sven Hedin, and to append my signature.

"GUGLIELMO MARCONI."

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Contract News

The following vessels have been equipped with Marconi Apparatus during the past month.

Owners.	Name of Vessel.	Installation.	Remarks.
Messrs. Elders & Fyffe ..	*Bayano*	1½ kw. and emergency set	Vessels taking limited number of passengers, with considerable fruit trade, between England and West Indies.
,, ,, ..	*Patia*	,,	
,, ,, ..	*Patuca*	,,	
	Grand Duchess Maria Nicolævna	,,	—
The Canadian Pacific Railway	*Empress of Asia* ..	,,	Passenger between Vancouver and Japan in connection with the C.P.R.
Greenshields, Cowie & Co. ..	*Knight Companion*	,,	—
James Chadwick & Sons ..	*Drumcliffe*	,,	Cargo vessel between Liverpool and Buenos Ayres.
Trinidad Shipping and Trading Co.	*Matura*	,,	Travelling between New York and Trinidad with fruit cargo.
The Orient Line	*Ophir*	,,	—
The Leyland S.S. Co.	*Cambrian*	,,	These vessels carry a limited number of passengers, but their transport between Liverpool and Boston is very considerable.
,, ,, ...	*Philadelphia* ..	,,	
The Gulf Transport Co. ..	*Indore*	,,	—
The Norfolk and N. American S.S. Co.	*North Point* ..	,,	Being part of an order to equip this line of vessels, which is engaged entirely in North Atlantic service.
,, ,, ,,	*South Point*	,,	
,, ,, ,,	*West Point*	,,	
Furness, Withy & Co. ..	*Kanawha*	,,	Engaged in general trade, no fixed destination
The White Star Line	*Ceramic*	,,	Passenger between Liverpool and Australia (refitted).
The P. & O. S.N. Co.	*Nellore*	,,	Travelling in Eastern Waters.
The British India S.N. Co. ..	*Manora*	,,	Passenger vessel between Calcutta, Rangoon and the Straits.
The London & S.W. Railway Co.	*Cæsarea*	,,	Passenger vessels engaged in Channel Island service.
,, ,, ,,	*Sarnia*	,,	
C. J. Barrie & Son	*Den of Ruthven* ..	½ kw. and emergency set	—
,, ,, ...	*Den of Crombie* ..	,,	—
The Hall Line	*City of Bombay* ..	,,	Part of large contract to fit this line of passenger vessels. They are engaged in service between Liverpool, Bombay, and Karachi.
,, ,, ...	*City of Norwich* ..	,,	
,, ,, ...	*City of Edinburgh* ..	,,	
Bucknall S.S. Co.	*Kasenga*	,,	Cargo vessels with world-wide service.
,, ,, ...	*Karroo*	,,	
The Tyne and Tees Shipping Co.	*New Londoner* ..	,,	Cargo vessel carrying limited number of passengers between London and Newcastle.

La Société Anonyme de Télégraphie sans Fil have equipped the following vessels.

Owners.	Name of Vessel.	Installation.	Call Letters.	Port of Registry.
Nasm	*Oosterdijk*	1½	PGX	Rotterdam
Norske Amerika Linien ..	*Kristianiafjord* ..	½	LCK	Christiania
Amsterdam Tug and Salvage Co.	*Atlas*	1½	PIB	Amsterdam
R.L.O.	*Vollrath Tham* ..	1½	SFV	Pitea

The following vessels have been equipped by the Debeg Co.

Owners.	Name of Vessel.	Call Letters.	Remarks.
Rickmers	*Andree Rickmers* ..	DND	—
D.A.P.G.	*Tecumseh*	DTC	Accounting through the Debeg Co.
,, ...	*Prometheus* ..	DOP	—
The Hansa Line	*Imkenturm*	DIM	—
,, ,, ...	*Solfels*	DOU	—
,, ,, ...	*Kybfels*	DKY	—
,, ,, ...	*Reichenfels*	DXR	—
The Hapag	*Bosnia*	DBZ	Cargo vessel
,, ,, ...	*Armenia*	DXM	Cargo vessel
The Kosmos Line	*Sakkarah*	DYD	—

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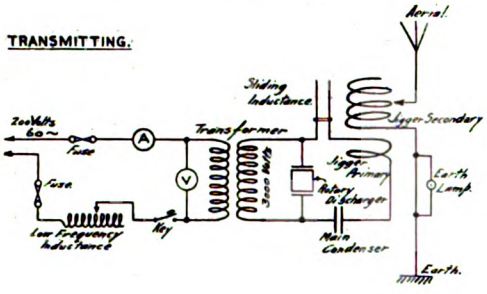
HINTS FOR AMATEURS

An Experimental Station.

By H. W. POPE.

IT is now a little more than two years since I commenced to experiment in wireless telegraphy.

The first thing I made was a single slide tuning coil, and I wound it on a 4 inch cardboard tube 24 inches long, with 18 gauge

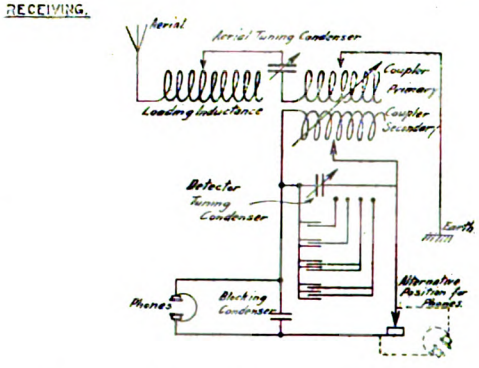


dcc. wire; I still use this coil as loading inductance for my loose coupler.

Quickly followed an inverted aerial about 120 feet long, on a 28 feet mast, at the end of the garden, the home end being fastened to the eaves of the house.

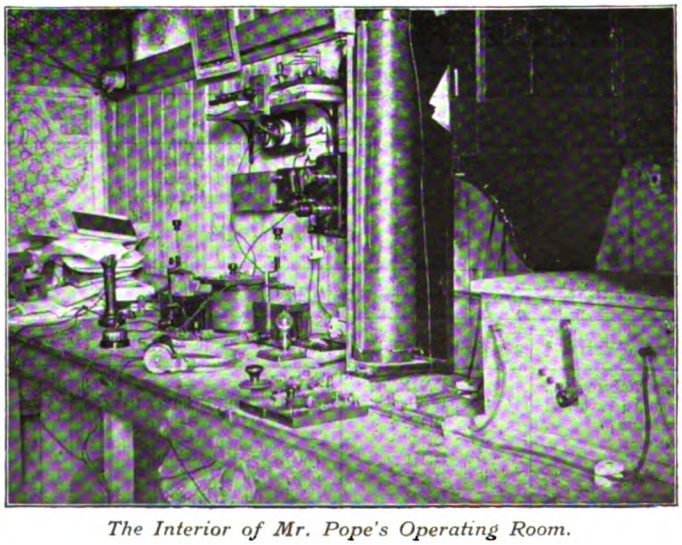
Other apparatus consisted of electrolytic detector with potentiometer and a small variable condenser. I also made a change-over switch with two screws, which stuck through a piece of wood and dipped into two sets of mercury cups for sending and receiving; and lastly I came across a pair of indifferent 'phones for 1s. 6d., but they were good enough for the half mile I wished to get signals over.

Later came the inevitable motor-coil, direct coupled helix, small home-made tapping key, and my solitary accumulator, but the spark gap was a thing of beauty in my eyes, ¾ inch spun brass balls, highly polished and nicely lacquered; but it was soon discarded in favour of zinc electrodes, which I found did not arc so quickly.



About ten months of experimenting with this small set, and sundry conversations with people more advanced than myself, brought home to me that my aerial was not high enough to do wonders with, so with the collaboration of a local builder I erected the present one. It is 65 feet high to the top of a mast on the roof, with a 45 footer at the end of the garden; the lead in is taken from the far end and brought back to the house, where it enters the out-building which serves for both cabin and workshop.

The total length of aerial is 230 feet down to the earth connection, and I find this form of aerial very efficient both for sending and receiving. It consists of two wires only, and there is, of



The Interior of Mr. Pope's Operating Room.

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course, not so much capacity as if I had four; but then it is long, and there is a more symmetrical distribution of power.

My new apparatus consists of the old single slide tuner done up, and now being used as loading inductance, a loose coupler with primary outside, wound with 20 gauge dcc. wire, and tapped off into four sections on a 5 inch cardboard tube 5 inches long, secondary which is hinged to loosen coupling, is wound with 22 gauge dcc. also tapped into four sections on a 4 inch cardboard tube 4 inches long. Aerial tuning condenser made with tinfoil on one side, and sliding zinc on the other, insulated with old ¼-plate negative glass, and the whole clamped in a wood case with cardboard strip separators where the zincs slide in; a pointer is attached to the zincs, and travels along a scale which is quite arbitrary, but forms a useful guide for future adjustments.

The detector tuning condenser is similar to the aerial tuning condenser, except that at the back there are four paper-insulated fixed condensers capable of being put in parallel with variable condenser by means of a small four-way switch.

I now use a zincite-bornite combination detector which is proved to be about equal in sensitiveness to the best of silicon detectors, but much more hardy, and if open circuited on both sides *close-up* seldom goes out of adjustment.

My sending gear consists of ¼ kw. transformer of my own design and construction, giving only 3,000 volts across secondary, but I find this low voltage quite satisfactory, even with a large amount of low-frequency inductance in. I am using a non-synchronous rotary discharger of the treadmill type, with flat blades, driven by a small 6 volt motor working on d.c. from accumulators. I also have a Marconi type sliding jigger and primary sliding inductance as used on the 1½ kw. set, also glass plate main condenser.

At present I can only use one wave, viz., 450 metres, but when I have made another similar condenser to put in series or parallel I shall be able to produce 300 and 600 metre waves, which will give me more flexibility in cases where the station I am working to is jammed.

My best-known results at present are as follows:—sending 22 miles to W. Malling in Kent, and am at present experimenting to St. Albans (30 miles). Receiving—I get Soller, Marseilles and all French and English coast stations.

In conclusion, I have to thank the *Marconigraph* for much useful information and interesting reading matter, and wish it every success in the future under its new title.

AMATEUR NOTES.

THE Postmaster-General has allotted the code letters XBS as a special wireless code signal for Boy Scout Troops.

* * *

It has been proposed to form an Amateur Wireless Club in Newcastle-on-Tyne, the objects being to secure a club-room, hold meetings for wireless experimenters' benefit, and generally bring together all interested. Intending members should send their names to Mr. Chas. M. Denny, of 24 Eversley Place, Heaton, Newcastle-on-Tyne, who proposes to arrange a meeting of those interested.

* * *

We have great pleasure in publishing on page 274 an article from Mr. Pope, who is evidently an ardent and enthusiastic amateur. We congratulate him on the sensible design of his apparatus and circuits, and even more on the extreme legibility of his MS. and the clearness of his diagrams. *O si sic omnes!* His literary form is perhaps somewhat breezy for a technical article, reminding one, indeed, a little of the epistolary style of the well-known "Visits of Elizabeth"; but it is eminently readable. We are a little uncertain as to his transmitter; the origin of that alternating current at 200 volts seems wrapped in mystery. And for everybody's sake we should recommend him to put in an air-core protecting "choke" between his oscillating circuits and his low-frequency transformer windings.

* * *

An interesting gathering took place at Bournemouth on June 10th in connection with the 1st Parkstone Troop of Scouts, the occasion being the inauguration of an electrical Morse signalling apparatus, the gift to the troop of the District Secretary, Mr. Alan Fletcher. Sending and receiving

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stations had been installed in the large hall and the smaller hall, which is the Scouts' "guardship." The Mayor, who is Assistant Sea Scout Commissioner for East Dorset, sent through the first official message, "Are you prepared?" and afterwards formally took over the apparatus on behalf of the troop, and expressed their thanks to the donor. The 1st Poole Troop, under the direction of Mr. W. E. Tydeman, attended.

* * *

The Birmingham Wireless Association, which has a membership of over 80, has met with cordial support from local amateurs. A club room has been obtained at Geoffrey Buildings, John Bright Street (entrance Severn Street), the aerial has been erected, and the room itself is being fitted up in a suitable manner. The aerial is divided into two similar parts, which may be used as one or independently, and this arrangement should be very useful for testing instruments such as 'phones, coils, electrolytic detectors, etc.

Although at the time of writing the silence room is just nearing completion, no instruments have yet been installed, but several meetings have been held. Mr. J. J. Shaw, one of the society's keenest committeemen and the well-known seismologist, has addressed a meeting on "Home-Made Apparatus," and gave his audience a great number of useful and practical hints in the construction of the same.

A meeting which evoked much discussion was one at which the vice-president, Mr. W. F. Baxter Bartram, spoke on "The erection of a good receiving station for £3." Another most interesting evening was spent when a member, Mr. R. Robinson, of the "Royal Engineers Wireless Section," gave the association hints on learning the Morse code, practice at low and high speeds of reading, and explained the routine of "ship and shore" messages. Forms of application for membership may be obtained from the secretary, Mr. J. B. Tucker, Brentwood, Solihull.

* * *

At a recent meeting of the Derby Wireless Club accounts were given by Mr. S. G. Taylor and Mr. A. T. Lee of experiments carried out this and last summer with various kites and small balloons, to which "aerial" wires were attached. When about 100 yards of wire were taken up the received signals were considerably louder than on an ordinary aerial. The natural "wavelength" of the wire appeared to be considerably less than that of the ordinary horizontal aerial, presumably owing to absence of capacity. The chief difficulty consisted in obtaining a satisfactory "earth." In the experiments last summer at the seaside, an excellent "earth" was easily obtained by trailing a few feet of wire on the damp sand. Inland, however, different arrangements had to be made. A single wire laid along the ground, or in a brook, was not found to be very efficient.

* * *

Mr. Taylor also described some experiments in which Induction Coil Secondary Sections were used as receiving oscillation transformers. The flat discs were tapped off for 600, 1,800, 2,100 and 4,000 m.WL., and gave very satisfactory results. He also exhibited some small wooden discs with a groove at the edge, in which was wound several layers of wire. Used as a loose coupler, Cleethorpes could be heard with the discs 6 inches apart, and, in series, Clifden. A "double-acting cartwheel jigger" might be obtained by placing a primary disc between two others. The "cart-wheel jigger" effected a saving not only in space but also in wire, as considerably less was needed than in the usual single-layer tuning coil. Signals from all the large stations were as good on the discs as on the ordinary type.

A young Kentuckian recently sued a telegraph company for the loss of his sweetheart, $1,999 being the value placed upon his wounded feelings. He telegraphed to his intended to meet him in Louisville for the wedding ceremony, but the message she received called her to Nashville. She went to Nashville and waited, and he went to Louisville and waited. Her disappointment was followed by anger, and she would not listen to any explanation. She thereupon broke off the engagement, and the disconsolate young man calculates that it will take about $1,999 in money to re-establish his former condition of mind.—*Telegraph & Telephone Age.*

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. To enable a reply to appear in the current number such questions should reach the Editor by the 12th of the month. Correspondents are reminded that all letters must be accompanied by the full name and address of the writer, otherwise their questions will not be answered.

G. C.—*Design of Receiving Station.*—I propose to erect a receiving station, but before making the various parts I should like your opinion upon my scheme. Am I right in supposing that, as I have so much adjustment capacity in the circuit—assuming, in the first place, that the connections, etc., are sound—a *variable* condenser is unnecessary? So far, I have a two-phase "jigger" in mind, the dimensions of which are as follows: *Primary*—Coil 12 inches long, 5 inches diameter, 8 S.W.G.: one layer each. *Secondary*—Coils 5 inches long, 6 inches diameter, 30 S.W.G. (adjustable). Is this all right? Is the idea of a two-phase "jigger" feasible at all? I notice that Marconi had one in conjunction with an ordinary coherer, but I have not heard of one with a crystal detector.

Answer.—A variable condenser is nearly always advisable, because it can be varied continuously instead of in "steps," as is the case with a variable inductance. If the latter is made with a slider making contact on the bared wire of the turns themselves, contact is apt to be unreliable; while if contact is made on tappings, one either has to have a multiplicity of tappings or else big "steps" in adjustment. A two-phase jigger is feasible; we have employed it with some success for crystals, but not with the connections shown by you, which are not quite right. The Marconi coherer-jigger had its secondary in two parts, as you show; but the two parts were joined at the centre by a fixed condenser. The whole was so designed that a half-wave was formed in it, giving a loop of potential at each end, and a node at the middle point. The coherer was connected across the ends, and therefore got the benefit of the maximum potential difference; while connection to choking-coils, relay, local battery, etc., was made on either side of the central condenser, at the node of potential. This plan should be adopted in your case; your crystal should not be put at the centre as you show; it would be advisable to put a very small variable capacity across the ends of the secondary, so as to form a closed oscillatory circuit, and to connect your crystal across that. Your battery and potentiometer—if you are using, as we advise, a crystal such as carborundum, which requires a battery—could then go to the two mid-points of the secondary, with telephones in series. Your jigger primary should not be as long as you mention, which would occupy the whole length of the secondary; it should be quite short—two narrow coils, one on either side of the central point of the secondary, would be best; this leaves the ends of the secondary properly free for the potential loops. Of course, the inductance which you lose by thus reducing your primary must be made up by external tuning inductance.

N. H.—*A Tuning Inductance.*—I wish to make a loose-coupled tuning inductance, using a load coil of 350 feet of No. 20 wire. Kindly give me particulars of a suitable jigger, giving quantity and gauge of wire and number of tappings, on primary and secondary; also sizes of variable condensers. I wish to tune to 4,000 metres. My aerial is 150 feet long, and I am using crystal detectors. In giving size of variable condensers, kindly give me area and number of vanes. Note that I want the primary and secondary tapped off; I do not want to use sliders.

Answer.—If—as we should judge from the tone of your letter—you are taking up "wireless" experimental work in a serious spirit, the best thing we can do for you is not to give the answers you ask for, but to show you how you should set about finding out for yourself. If you were setting to work seriously to learn a new language, you would not begin by getting some deep book written in that language, and then write and ask what each word meant; even a dictionary would not help you much in such a proceeding, because a dictionary takes for granted that you are in a position to apply the various rules of declension and conjugation and so on. Apply this in the case of wireless telegraphy.

In the first place, it is necessary to know the relations between velocity, wave-length, frequency of electric waves, and their connection with the values of capacity and inductance. When you have got this all clear, and realise what resonance and "tuning" really mean, you will be able to see the use of a certain little formula which crops up everywhere in "wireless"—namely:

λ = wave-length in metres = $1885 \sqrt{\text{Cmfds} \times \text{L mhys}}$

which gives the wave-length in metres in terms of the capacity in microfarads, and the inductance in microhenries. In the second place, you must make or buy—preferably make—a wave-meter. If you buy one, it will, of course, be calibrated; if you make one, you should endeavour to calibrate it yourself by some method which will be instructive and sufficiently accurate for your purposes. For instance, the wave-length given by a straight vertical wire is very nearly accurately four times the actual length of the wire; so by comparing your wave-meter readings with the lengths of the wire you can get several points on your calibration curve. You cannot proceed in this manner indefinitely, because you cannot get an indefinite length of vertical wire; but there are several ways of going on. For instance, if you make your condenser four times as large—(how can you make it four times as large? By putting a fixed condenser, three times as large as the maximum value of your original condenser, in parallel with the latter. How can you tell when you have made the fixed condenser three times as large? By the knowledge you have just obtained of the beginning of your calibration curve: think it out)—you know from that useful little formula just quoted that your wave-length will now be twice as long as the longest possible on the first condenser. Or you can multiply the inductance coil of your wave-meter by four, or nine, or sixteen, and similarly increase its range; and you can arrange plug or other switches to change from one range to another. If you once get started in the right way, it will soon be clear to you that it is a matter of common-sense.

When once you have got your wave-meter, and have found by familiarity that there are different ways of employing it usefully, you will begin to see that you could answer all your questions yourself; not truly accurately, but sufficiently accurately for your purpose, while at the same time you would be making real progress along the

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right lines. If you want to get strictly quantitative results, you will require as a standard of reference either a capacity or an inductance of known value. This you can buy, ready standardised, or you can make one from first principles; or you can make use of data (such as are given in the recently-published "Year Book of Wireless Telegraphy and Telephony"); for instance, that the capacity of a square metre of flat plate, placed at a distance of 1 centimetre from a similar parallel plate, with air between, is ·00088 of a microfarad.

Turning to your specific questions; you can, by the use of your wave-meter, find the "natural" wave-length of your aerial; you can then add in series to it a succession of coils of equal inductance (made equal and confirmed by the use of that same wave-meter), and plot a curve showing the tendency of your particular aerial to increase in wave-length with added inductance. By such a curve you can see at once how much inductance is necessary to obtain a given wave-length. As it is not convenient to add inductance in very small steps, nor to make use of a slider (which is not a particularly reliable contact for such delicate things as weak signals), it is advisable to have a continuously-variable condenser in series with your aerial; as a general rule this can be kept "short-circuited" for a rough adjustment, and used for a final adjustment to bridge across two steps of added inductance. What is the effect of such a condenser in series with the aerial, and how can it be used for such a purpose? Think it out, from first principles.

As for the sizes of variable condensers, etc., one thing is definite—namely, that they must be so proportioned to the inductances that the formula $\lambda = 1885 \sqrt{CL}$ holds good. In your crystal circuit itself, to get the *best* results you would have to change the proportions of C and L so as to suit the particular kind of crystal. With a high-resistance crystal, such as some kinds of carborundum, the higher potential you get at the crystal the better, so that C should be made very small; its maximum value—for it should be adjustable—might be measured in ten-thousandths of a microfarad. With low-resistance crystals, current rather than potential should be sought for, and the capacity should be larger, and the inductance less.

W. H. G.—*Telephone Receivers.*—I should be grateful if you would give me a little information regarding telephone receivers suitable for wireless telegraph work. Is it necessary to have a receiver of any special design mechanically? How is the required resistance determined? Can you advise me of any evening classes running during the summer months where I could obtain instruction in wireless telegraphy?

Answer.—For reply to the bulk of your question, see replies in this and former numbers. In the matter of special mechanical design, with regard to the telephone itself, the diaphragm should be thin; poor results are obtained with certain commercial telephones owing to the thickness of their diaphragms. Then, of course, the headgear should be so designed as to press the receivers firmly and closely to the ears. With regard to evening classes, we would advise you to study the article on "The Wireless Operator" which appeared in the May number of THE WIRELESS WORLD. Full particulars appear there of the classes at Marconi House. If you are not eligible for those classes you might communicate with a telegraph training school, a good selection of which appears in the advertisement pages of THE WIRELESS WORLD.

G. H. D.—*Ranges.*—How far should I be able to receive with the following apparatus? An inverted L aerial, 100 feet long, lead of 50 feet from the top end, which is 75 feet high.; the lower end being 35 feet high. (2) Double-slide inductance (12 inches long), a gold-silicon detector, a double phone headgear (2,000 ohms), and a blocking condenser of about ·002 mf. How far should it be possible to send with the same aerial, a 4-volt accumulator, ¼-inch spark-coil, Leyden jar condenser about ·004 mf., and a helix?

Answer.—See reply to G. L. in May number. In any case your information is far too vague; "a double-slide inductance, 12 inches long," might be of any value. Moreover, what do you mean by "how far should I be able to receive"? You might receive one station well at a distance of 300 miles, and fail entirely to get signals from another station at half a mile. Your aerial sounds quite a good one, your telephones seem of a suitable type, and if you are not "shut in" badly by buildings or hills, and if you are a skilful experimenter (this is perhaps the most important point of all), you should be able to receive quite a number of English coast stations, and large stations in Spain, France and Germany if they come within your range of wave-length, whatever that may be.

M. P.—*Receiving Station.*—I wish to put up a receiving set to receive from the coast stations, if possible. I can use two poles, one 30 feet high, the other 15 feet; they are 80 feet apart. (1) What size S.W.G. copper wire shall I use for aerials, and how many lengths are these connected in series? (2) What shall I make the length of tuning coil with one slider, what is diameter of this coil, and size of wire? (3) What are lengths and diameters and size of wire for primary and secondary of jigger? (4) What is capacity of variable condenser (capacity in microfarads)?

Answer.—You might either use a "twin-wire" aerial—two wires side by side, but separated by four or five feet—or a sausage-shaped multiple aerial made up of, say, six wires spaced equi-distantly round light wooden hoops some three feet across. The size of wire is not of much importance for your purposes; 7/22 stranded is a usual size, but you could do with something lighter. We do not understand what you mean by "how many lengths are connected in series?" If you wind your tuning-inductance on a 3½-inch diameter cardboard tube, using No. 28 S.S.C. wire and winding to a length of one foot, you should have a range of tuning which would about reach to the Poldhu wave. We do not recommend "sliders"; it would be wiser for you to take tappings off at intervals instead. Your jigger-secondary might be wound with the same wire, and on a former, say, 6-inch diameter. If this is wound to a length of about 8 inches, and the capacity across it is made to vary from a very small value to a maximum value of ·0002 microfarad, the range of the circuit thus formed should be about what you want. Such a condenser could easily be made from one piece of brass tubing sliding over another piece of smaller diameter, the two being separated by an insulator such as layers of paraffined paper. If you happen to be using low-resistance crystals, you will get better results with a larger condenser and a smaller jigger-secondary. Your jigger-primary should have a variable coupling to the lower end of the secondary, and the crystal should be connected to the upper end of the latter, so that the battery and potentiometer come so as to connect to the lower end—*i.e.*, the end which is coupled to the earthed primary. The primary might be a coil about 1½ inch long of No. 22 wire.

J. B. H. inquires telephone transformer connections and other queries.—You have not quite got hold of the idea of the use of a transformer; the fine-wire winding should be put in the circuit exactly in the place where the telephone itself would normally go if it were suitable for use without a transformer, and the telephone should be connected directly across the thick-wire winding. You have this latter part right in your sketch, but your crystal is shown in quite a wrong place with respect to the rest of the circuit. With regard to your transmitter, the fact that you say your condenser consists of six sheets of tinfoil, 4 inches by 5 inches, and do not mention what they are separated by or how far they are apart, suggests to us that your ideas want putting on a sound basis. Altogether, we should recommend you to read the series of instructional articles coming out now in this paper before setting to work experimentally. It is absolutely essential that the principles of electricity in general and of "wireless" in particular should be grasped thoroughly to start with.

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Patent Record

The following patents have been applied for since we closed for press with the June number of this magazine:

No. 11,833. May 21st. H. L. Short, A. E. Short and H. O. Short. Wireless telegraphy.

No. 11,945. May 22nd. Laurence B. Turner. Contact make and break device adapted for use in wireless telegraphy and other purposes.

Nos. 12,074, 12,075, 12,076 and 12,157. May 23rd. Wm. Theodore Ditcham and Grindell Matthews' Wireless Telephone Syndicate, Ltd. Oscillation sparkgaps, microphones for use in wireless telegraphy, apparatus for use in wireless telephony, switching arrangement for use in wireless telegraphy and telephony.

No. 12,942. June 4th. Wm. Albert Freeman. Wireless transmitting and recording apparatus.

No. 13,503 and 13,504. June 5th. Thomas Harvey. Apparatus for detecting and magnifying minute electrical oscillations, receivers for wireless telegraphy.

No. 13,065. June 5th. W. T. Ditcham and Grindell Matthews' Wireless Telephone Syndicate, Ltd. Call or alarm apparatus for use in wireless signalling.

No. 13,310. June 9th. J. Hays Hammond, Junr. System and apparatus for radio control.

No. 13,458. June 10th. Robert Pickersgill Howgrave-Graham. Electrical device for the selective detection of periodic electrical impulses.

Nos. 13,636 and 13,637. June 12th. Marconi's Wireless Telegraph Company and C. S. Franklin. Receivers for use in wireless telegraphy and telephony, means for increasing the frequency of alternating currents.

No. 13,755. June 13th. Wm. Hamilton Wilson. Production of high tension discharges.

No. 13,793. June 14th. James Alex. Gardner and Alexander Ferguson. Apparatus for causing electrical impulses for transmission to a distance.

Athletics

On Saturday, June 14th, the Marconi Athletic Club held their first annual sports. The club ground at Acton was looking its best, and the weather was all that could be desired, while the light garments of the competitors and the summer dresses of the fairer section of the company helped to make a particularly picturesque scene.

As regards the feats done that day, the club has every reason to be proud of the results, for some of the events were won in excellent time. The Silver Cup, given by Mr. W. W. Bradfield for the quarter mile championship, aroused the keenest rivalry, and resulted in some very good heats, while the final was fought out in brilliant

A Group near the Winning Post.

style, F. W. Noakes eventually winning from F. J. Menear by about three yards. The other races were:

The Hundred Yards Handicap: Winner, W. C. Jewell. (The first prize for this race was a silver cigarette case, presented by W. Mackie, Esq.)

Throwing the Cricket Ball: Winner, F. W. Noakes, who gave an excellent display, making a distance of 96 yards.

High Jump: Winner, D. French, at a height of 4 feet 9 inches.

Half Mile Handicap: Winner, E. G. Buttfield from scratch.

Competitors in the Potato Race.

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Victoria Cross: Winners, A. R. Williams as rescuer, and Pannel as the wounded comrade.

One Mile Flat Handicap: Winner, E. G. Buttfield, with 10 yards start.

Potato Race: Winner, E. J. Wagstaff.

Sack Race: Winner, W. Holloway.

Thread-Needle Race: Winner, W. C. Jewell.

Three-Legged Race: Winners, E. G. Casserley and W. T. Kipling.

Veterans' Race: Winner, Geo. Pells.

One Mile Walk: H. G. Pearce. The prize, a silver cigarette case, was presented by Mr. S. Strickland.

There were besides two departmental races, which aroused the keenest interest: the first was a relay race, which was won by the accounts department, the second was the tug-of-war, in which a brave struggle was finally decided in favour of the school. At the close of the meeting the prizes were presented by Mrs. Bradfield, who was accorded a hearty vote of thanks for her kindness. Then followed a concert, given by members of the Marconi staff, from the platform of the pavilion; by this time it was growing dark, so that the fairy lights which outlined the pavilion produced a very dainty effect. The programme was varied and excellently rendered, and made a fitting conclusion to the afternoon's enjoyment. The sports committee, and especially the indefatigable secretary, Mr. H. G. Pearce, are much to be congratulated on the success of their enterprise.

A Musical Society

It has been decided to form a musical society in connection with the Marconi Athletic Club. An orchestra of twenty members has already been formed, and the first rehearsal was held on Tuesday, June 24th. The conductor, Mr. H. F. White, will be glad to hear from intending members. It is also proposed to rehearse songs, quartettes, glees, etc., if a sufficient number of singers are forthcoming.

Movements of Engineers

E. C. Montague, from foreign service leave to Poldhu.

E. Bellini, from Italy to London, and afterwards to Holland for demonstrations.

F. S. D. Marden, from Poldhu to Head Office.

L. S. Payne, from Liverpool to Newcastle: ship-fitting, and afterwards to the Canadian Company for land station erection.

G. S. Kemp, on sick leave from Letterfrack.

D. H. Payne, from London to Clifden.

C. H. Taylor, from London to New York.

O. Trost, from Cefn Dhu to London, and afterwards to Towyn.

H. J. Round, from London to Towyn.

C. James, from Liverpool to Hull (trawler tests).

T. E. Hobbs, from London to Hull (trawler tests).

B. S. Benning, from London to Hull (trawler tests).

J. M. Poyntz, from Broomfield to Poldhu.

E. L. A. Mathias, from Broomfield to Poldhu.

J. H. Shannon, from Cefn Dhu to Canada for the erection of land stations.

A. H. Morse, from Broomfield to Head Office.

Movements of Operators

J. R. Driscoll, London School to *Scotian*.

P. Denison, London School to *Trent*.

G. J. G. Nicholls, London School to *Dominion*.

L. H. Cox, London School to *Adriatic*.

N. Sedding, London School to *Devonian*.

A. R. Brown, London School to *Campania*.

M. E. O'Carroll, London School to *Letitia*.

M. W. Meredith, London School to *Columbia*.

D. Arbuckle, London School to *Parisian*.

A. W. N. Evans, London School to *Hesperian*.

H. C. Wills, *Galway Castle* to *Ruahine*.

E. A. Planterose, *Avon* to *Trent*.

G. C. Fenton, *Scandinavian* to *Bayano*.

W. H. Ponsford, *Caledonia* (Anchor Line), to *Scandinavian*.

A. C. Lund, *Virginian* to *Malta*.

T. Stubbs, *Devonian* to *Minnehaha*.

W. Crabb, *Galileo* to *Guelph*.

R. H. Packer, *Minnehaha* to s.y. *Iolanda*.

C. P. Litchfield, *Minnehaha* to *Den of Ruthven*.

C. H. Banner, *Saxon* to *Asturias*.

G. McCormack, *Victoria* to *Virginian*.

J. H. Rockey, *Hesperian* to *Devonian*.

J. O'Connor, Liverpool School to *Canada*.

P. J. Renshaw, *Adriatic* to *Ultonia*.

J. G. Buttle, *Columbia* to *Mesaba*.

B. Basson, *Dominion* to *Iroquois*.

Wilfred Taylor, *Dominion* to *Cluny Castle*.

G. H. Thomas, London School to *Asturias*.

E. Murphy, *City of Marseilles* to *Montcalm*.

A. Cookson, *Gloucester Castle* to *Mongolia*.

S. A. Leith, *Pancras* to *Atahualpa*.

J. R. Bamford, *Himalaya* to *Darro*.

T. Robb, *Gothic* to *Menominee*.

W. S. Croughton, London School to *Mesaba*.

O. G. Mauro, London School to *Ascania*.

C. J. A. Gill, *Corinthian* to *Knight Companion*.

A. H. d'Avigdor, London School to *Ultonia*.

J. W. F. Carleton, *Tainui* to *Ballarat*.

D. M. Sproat, *Wayfarer* to *City of Marseilles*.

A. J. Thompson, *Campania* to *Adriatic*.

J. Camfield, *Haverford* to *Ulster*.

S. H. Devereux, *City of Bristol* to *Royal George*.

H. S. Smith, *Hawke Bay* to *Galileo*.

G. W. O'Brien, London School to *Minnehaha*.

C. T. Parker, *Norseman* to *Dover Castle*.

J. H. Moores, Liverpool School to *Darro*.

T. M. Blackshaw, *Haverford* to *Atahualpa*.

H. A. Bowman, *Campania* to *Welshman*.

B. F. Emery, *Novara* to *Angora*.

H. A. Flick, *Angora* to *Novara*.

R. Sweetnam, *Highland Piper* to *Egypt*.

L. C. Duggan, London School to *Carmarthenshire*.

W. E. Tyler, *Laconia* to *Victorian* (Leyland Line).

A. W. L. Owen, *Hypatia* to *Laconia*.

R. V. Patrick, *Kinfauns Castle* to *Saxon*.

F. V. Kinder, *Virginian* to *Flamenco*.

W. C. Ryan, *Orontes* to *Montreal*.

C. J. Brett, *Goth* to *Waimana*.

B. S. Elliott, London School to *Empress of Asia*.

J. G. Bull, *Waimana* to *Manhattan*.

M. W. Woollam, London School to *Minnewaska*.

G. K. Flagg, *Danube* to *Avon*.

H. J. Stanley, *Iroquois* to *Nore*.

F. A. Thomson, *Highland Scot* to *Highland Piper*.

H. A. Whitmore, *Malwa* to *Themistocles*.

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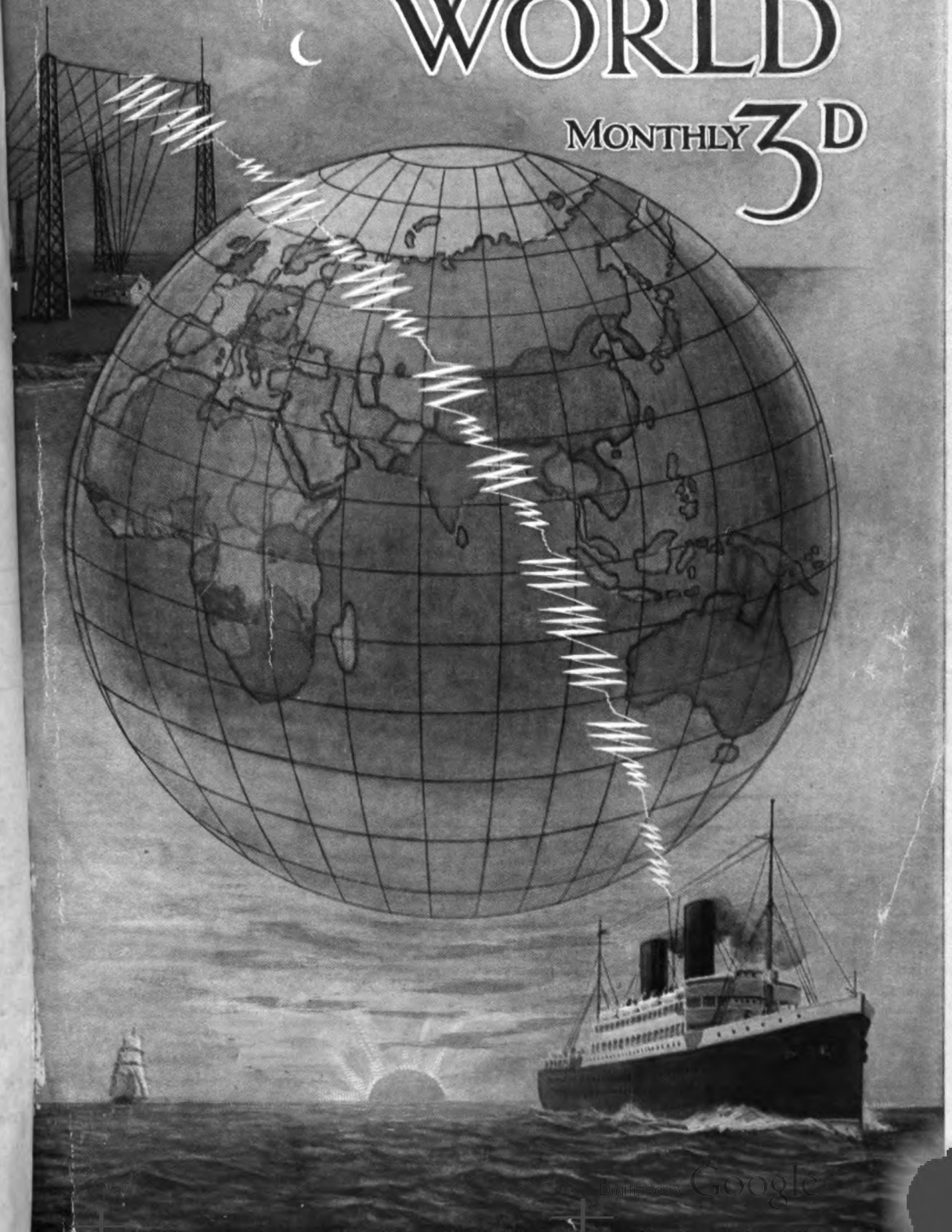

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The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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A FICTION EXPOSED

IN the course of a discussion in the House of Commons on July 15th, Major Archer-Shee gave further currency to a statement which, as far back as October last year, was widely published in the newspapers of this country. The statement was to the effect that a wireless company had been registered and had acquired the rights of the Poulsen-Pedersen system and "to establish communication between England and Canada, receiving a subsidy of £15,000 per annum from the Canadian Government." Speaking in the House of Commons, Major Archer-Shee said, "The Canadian Government had given this contract" (to the Poulsen Company) "for their stations across the Atlantic. At least they have approved of their starting them and have given them a subsidy." The Postmaster-General here intervened and informed the House that it was not the case that the Canadian Government had given a subsidy.

This was the first occasion on which an obviously inspired rumour was officially denied in this country. But the official reports of the Canadian House of Commons even more emphatically expose the inaccuracy of a misleading statement which was allowed to circulate in the Press without repudiation and was artlessly repeated in the House of Commons. We extract the following from the Official Report of the Canadian House of Commons debates for Wednesday, May 14th (Vol. XLVI., No. 93):—

"On the motion of the Hon. L. P. Pelletier (Postmaster-General) House went into Committee on the following proposed resolution (Mr. Deputy-Speaker in the Chair):—

"Resolved, that it is expedient, in connection with Bill No. 188, now before this House, intituled 'an Act to provide for more advantageous telegraph communication between Canada, the United Kingdom, and other parts of the British Empire,' to authorise the Government of Canada, if it deems it to be in the public interest, and under the circumstances and conditions set forth in the agreement in the schedule to the said Bill, to purchase the stations, apparatus, equipment and licences mentioned in the said agreement."

"Mr. MACDONALD: In view of the fact that the Marconi system has been in successful operation in Canada, why does the Postmaster-General discard it and inaugurate this Poulsen system? Has the science of wireless telegraphy reached such a stage that where two systems are used there is no danger of one system intercepting the messages of another?

"Mr. PELLETIER: Nothing in this Bill prevents the Marconi from doing business and being a competitor with this company. The only thing this Bill does is to provide for a new competitor, and that competitor receives no privilege, no subsidy, and no monopoly. It is simply a question of having a competitor who will bring down the prices of transmission."

We must leave the public to draw their own conclusion from a comparison of the two statements reproduced above; it will have served some purpose, however, if it inclines them in future to accept with greater reserve the "Wonderful Wireless Achievements" concerning which information is published on the unsupported testimony of those who are responsible for the alleged "achievements."

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COL. T. T. HEFTYE.

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Personalities in the Wireless World

COLONEL THOMAS THOMASSEN HEFTYE

Director-General of Telegraphs, Norway

THE ratification of the Norwegian agreement with the Marconi Company for the establishment of a trans-Atlantic service introduces a striking personality in Col. T. T. Heftye, the Norwegian Director-General of Telegraphs. Born in Christiania on April 10th, 1860, Thomas Thomassen Heftye was the son of a prominent banker. His father, a Swiss by birth, spent the greater part of his life in Christiania, and acted as Honorary Consul for Switzerland in that city. He was a man of great ability, and, as proof of the recognition of his splendid qualifications, he was offered the Chancellorship of the Exchequer. But this honour he refused, as he was by nature a man of retiring disposition, and only a sense of public duty made him take up anything like an official capacity.

His son, who is to-day the Director-General of Telegraphs in Norway, entered the University at Christiania when he was 18, and studied there for two years. After that he took up a business career, and for five years was engaged by firms of repute as their representative abroad. This brought him in touch with the ideas and movements of other countries than his own, and did much to widen an already keen intelligence. Besides, he acquired thereby considerable skill in languages, of which his thorough knowledge of English and French is a proof. But the career he had started upon was not to the taste of young Heftye. He wished to become a soldier, and with this end in view he entered a Norwegian military college in 1887. Afterwards he was gazetted to the Corps of the Royal Engineers, and when he had passed the Superior Military Technical Academy he was gazetted as sub-Lieutenant in 1893. Two years later he obtained his captaincy. For five years he devoted himself entirely to his profession, and was rewarded by appointment as Military Attaché at the Legation in Paris in 1900. Everywhere he went he made fast friends, for to his splendid talents were added great force of character, a graceful modesty, and an engaging geniality.

Politically he was a Liberal, and this marked him as a man of original thought. But the holding of such views was detrimental rather than an advantage to him, for at the time when he was entering upon his career it was the fashion for all men of good family to be Conservative, and his whole-hearted support of Radicalism helped to thin the ranks of his would-be supporters. Even his father was Conservative, so that Col. Heftye had to fight, and fight strenuously, for his principles. He did fight, and he won. In 1903 a Liberal Ministry took office, and he was made Minister of National Defence. On assuming this responsible position he was gazetted colonel in the army. Shortly after this, however, his party left office, and with them he resigned his appointment. In 1905 he was first appointed Director-General of Telegraphs, but this post he vacated three years later, when another Liberal Ministry was formed, and he was again appointed Minister of Defence. On this occasion, however, he failed to accept the principles of his party, and, after holding office for only three weeks, he resigned, and took up his old post as Director-General of Telegraphs. Perhaps it was fortunate for Norway that he did so, for the subject of wireless telegraphy soon became so important that the question of a national system could no longer be overlooked. With his usual energy he studied every part of the question, and reached the conclusion that it would be a splendid thing for Norway if she possessed such a system as was mooted. Once he was convinced of its advantages, he threw his whole support in favour of the scheme, and it was largely due to him that the Bill passed the Storthing by the huge majority of 99 out of 115 votes.

B

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EPISODES OF THE MONTH

SHOCK-EXCITATION. AMATEUR LICENCES AND THE NEW POST OFFICE CHARGE. MARCONI DEVELOPMENTS IN BRAZIL. INTERNATIONAL TIME SIGNALS. WIRELESS IN STEAM FISHING FLEETS.

THE reaction of secondary on primary in a coupled-circuit transmitter, and the consequent formation of "beats"—equivalent to the presence of two different frequencies—in the waves emitted from the aerial, has for some time occupied the attention of wireless engineers. The avoidance of such reaction, by the rapid quenching of the spark, forms one of the advantages of the modern Marconi discharger. Dr. Eichhorn, in an article which we have great pleasure in publishing on p. 294 of this issue, deals with other methods for obviating the same phenomenon. The application of these methods—which are based on the researches of Prof. Wien—under various conditions of coupling and spark-length, and the effect on the requisite tuning, is discussed; and though there may not be anything said which is particularly new, the whole subject is reviewed in an interesting way. For the moment we cannot quite see how Dr. Eichhorn can reconcile his definition of the coefficient of coupling as $k=\frac{\nu'_1-\nu'_2}{\nu}$ with his equation for the periods of the two waves $T^1=T\sqrt{1+k}$ and $T''=T\sqrt{1-k}$.

* * *

Some dissatisfaction has been caused in amateur wireless circles by the announcement that in future a charge of one guinea "to cover the office expenses connected with the issue of the license and the inspection of the installation" is to be made on all licenses issued. Much of the dissatisfaction rests, however, upon a misunderstanding of the object of the charge, and upon the mistaken fear that it will have to be paid annually. Licenses are granted under the Wireless Telegraphy Act of 1904, Clause 2 (1), which empowers the Postmaster-General to grant a license to an applicant "whose sole object of obtaining the license is to enable him to conduct experiments in wireless telegraphy." The license is granted "subject to such special terms, conditions and restrictions as the Postmaster-General may think proper," but it is not to be subject to any "rent or royalty." Doubts have been expressed as to whether the charge can be enforced legally, but we understand that the Post Office have been advised that they are strictly within their rights in imposing the charge. As a license is, under ordinary conditions, permanent, there will be no other registration expenses besides the initial outlay of one guinea, unless a station should be so altered and re-equipped in such a manner as to make a new license necessary, and then the fee of one guinea will be charged. This fee applies to all proposed experimental stations, whether they be for receiving only or for both receiving and transmitting purposes. The charge is no doubt due to a great increase in the number of applications for licenses, and there is a good deal to be said in its favour. Indeed, we doubt very much whether any serious experimenters are likely to take exception to the nominal fee which they are called upon to pay. If, on the other hand, the fee will suppress the irresponsible "amateur" who takes only a passing interest in the art of wireless telegraphy, and who, with his toy apparatus, merely endeavours to make himself a public nuisance, no one will be any the poorer, whilst those who conduct genuine experimental researches will gain considerably in influence. This is the class which, after all, counts for anything, and which should receive encouragement. In this connection we may welcome the increase in the number of amateur wireless clubs in this country. The "club" movement has not been in existence long, but already there are about half a dozen clubs either formed or proposed. We are probably only at the beginning of what will ultimately become a very large and useful movement, with associations of amateur experimenters in every important centre

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co-operating for the common benefit of their members.

* * *

Vice-Admiral Belfort Vieira, the Brazilian Minister of Marine, in his annual report to the President of Brazil, states that the wireless telegraph service in the Republic has increased during the past year. Wireless stations are to be erected at Rio de Janeiro, Bauru, and Porto Murtinho, which will enable communication to be established with the base of the Matto Grosso squadron. The contract for these stations has been awarded to Marconi's Wireless Telegraph Co., Ltd., and a commission has been appointed, consisting of three officers of the navy and a representative of the Marconi Company. Another station at Santa Martha will communicate with ships south of the Republic. The Minister's report adds that the naval wireless telegraph stations have worked with unfailing regularity. New Marconi stations have been purchased, and, in the opinion of the Minister of Marine, the good results obtained justifies the adoption of the Marconi system in the Brazilian Navy. It is proposed to transfer the apparatus which was formerly used in the Ilha das Cobras station to Abrolhos, and to adapt the former as a training school for wireless operators.

* * *

The growing commercial importance of wireless telegraphy was emphasised by the inauguration on July 1st of a new international system of wireless time signals. Up to the present time only two wireless stations have transmitted regular time signals—Norddeich and Eiffel Tower. Each of these two stations had its own system of preliminary signals, that of Paris being rather elaborate and confusing to the inexpert, besides possessing the additional peculiarity (to the British mind) of sending the actual "time" signal at such awkward moments as 10.49 a.m. and 11.49 p.m. The German station has had a far more simple and convenient method—a preliminary signal that could easily be understood, followed by the actual "time" at Greenwich midday and midnight. Paris and Norddeich have a normal range of about 1,000 miles, so that only a limited area had the benefit of the correct time free of charge by wireless telegraphy. At an international conference in Paris last October the new world-wide time signals were formulated, and some idea of the new range to be covered can be gathered from the fact that such high-power stations take part in the new scheme as San Francisco, Timbuctoo, Manila, Mogadiscio (Somaliland), San Fernando de Noronha (Brazil), Paris, and Norddeich. The procedure will be identical at these and other stations, and all time signals will be sent exactly on the hour by Greenwich time, though each station has its own allotted hour, and two or three of them will send two signals during the twenty-four hours.

* * *

That the application of wireless telegraphy to trawlers is now practicable was demonstrated beyond a doubt by the successful experiments carried out in the North Sea during the past month. These were made on the trawler *Othello* and the carrier *Cæsar*, owned by Messrs. Hellyers' Steam Fishing Co., of Hull. Having regard to the size of the trawler, its mast facilities and the work carried on by a vessel of this type, it was decided that the most suitable form of wireless equipment would be a type approaching as nearly as possible the Marconi standard ½-kw. set. Two installations of this power, but of somewhat different designs, were therefore placed aboard the trawler, and light topmasts were carried to take the aerials, whilst two installations, each of 3-kw., were placed in the carrier. An average range of 90 miles was aimed at. The vessels left Hull on June 11th, and proceeded towards the coast of Denmark. At a distance of 270 miles from Cullercoats the *Cæsar* sent and received messages without any difficulty; thus the estimated range was considerably exceeded, and the strength of signals in both directions was such as to indicate that the range of 270 miles could be increased still further. With the *Cæsar's* aerial lowered to 65 feet above the water-level, she communicated with Scheveningen at 195 miles. The *Othello*, which was equipped with a Marconi portable installation, was able to communicate with Cullercoats, 180 miles away, messages being freely exchanged at that distance, and also with the *Cæsar*, a distance of 100 miles. We hope to publish full details of these important trials, together with particulars of the types of apparatus with which it is intended to equip trawlers, in an early issue.

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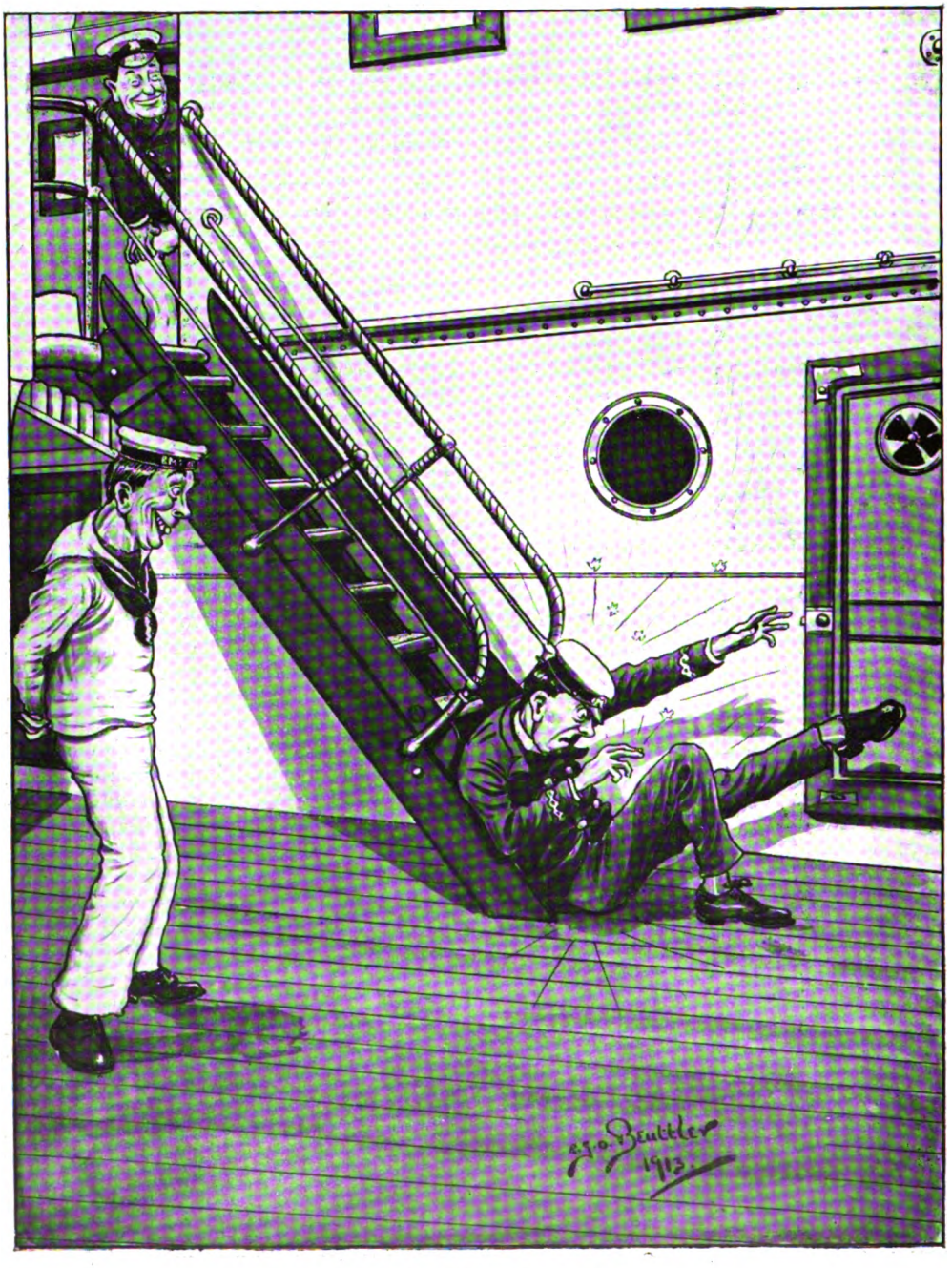
CARTOON OF THE MONTH

Wireless Terms Illustrated



V.—A Sliding Contact

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A Transatlantic Wireless Station

IN THE LAND OF BEAUTY, MYSTERY AND PROGRESS

RATIFICATION OF CONTRACT WITH THE MARCONI COMPANY BY NORWEGIAN PARLIAMENT. ITS EFFECT ON THE SHIPPING INDUSTRIES. SITES PROPOSED FOR STATIONS. STAVANGER AND ITS CATHEDRAL. THE PEOPLE OF NORWAY. THEIR INDIVIDUALITY AND SOCIAL LIFE. NAERBO.

NORWAY looms large in the mind of the public at the present moment, for is it not the holiday season, and this, the land of fjords and mountains—double-starred in the mental Baedeker of the tourist—is one of the beauty spots of the world. But it has also been brought prominently to notice by the announcement that on June 28th the Storthing decided to adopt a Transatlantic wireless telegraph scheme which had been negotiated with the Marconi Company.

This scheme is of greater national importance than at first sight seems apparent. Norway has a very large shipping business, the mercantile fleet ranging fourth in the world as far as tonnage is concerned. Many of these ships trade in American waters, and over one million of Norway's sons are settled in the land of the Stars and Stripes. The want of adequate Transatlantic telegraphic facilities has not been relished by the Norwegians, who have lacked hitherto direct means of communication with the North American Continent. Cable-laying was impossible, mainly on account of the high cost, and the only hope, therefore, rested in wireless telegraphy. This alone offers to satisfy the aspiration of Norway to be in direct touch with the American continent, and it can well be imagined with what pleasure the public welcomed its development. Hitherto the country has enjoyed the advantages of wireless telegraphy on but a small scale; there are about six stations scattered along the coast, in addition to one at the Spitzbergen Islands. Only three of these stations, however, are of any importance, viz., Bergen, Ingo and Spitzbergen, and these are employed for communicating with ships.

In September last the Norwegian Telegraph Administration concluded a provisional contract with Marconi's Wireless Telegraph Company, Ltd., for the erection of a high-power station to communicate with a similar station to be erected by the Company in the United States. The price to be paid to the Marconi Company for the erection of the station was £70,000, and the Company were further to receive a royalty of 10 per cent. on the gross receipts of the undertaking for a definite period. This contract was subject to the approval of the Norwegian Parliament, but, before it could be ratified, the Government resigned, and their successors decided to submit the scheme to the consideration of a representative committee appointed by the Storthing. After very careful deliberation, this committee came to the conclusion that the scheme would be of great benefit to Norway, and they decided to recommend the ratification, subject to one or two modifications which were agreed to by the Marconi Company. The committee was presided over by Mr. Mowinckel, a leading ship-owner of Bergen, and among its members was Admiral Sparre, and both these maritime experts spoke strongly in favour of the scheme when the question of its ratification came before the Storthing on June 28th.

The transmitting station will be erected on Ullenhaug, near Stavanger, on the south-west coast of Norway. The Government propose to provide trunk lines connecting all the important towns in the country direct with this station. The electrical energy which is required to produce the waves employed

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View of Stavanger.

in wireless telegraphy will be supplied by the town power station, whose power is derived from the immense water supply situated in the range of mountains at the back of Stavanger. The power supplied will be 3-phase alternating current, and the voltage of the transmitting line 30,000 volts. The current will be transformed down to a suitable voltage for running the motors employed in the transmitting station.

The sites for the station near Stavanger, also that for the receiving station at Naerbo, which is about 17 miles south of Stavanger, were chosen some time ago, so that no time should be lost in commencing the constructional work. The Marconi Company were confident that the searching technical investigation that had been made into the somewhat similar contract for the proposed stations for the Imperial chain would result in the final ratification of the Norwegian contract, and as a result of this confidence the Company have progressed with the details of the designs in these stations, and are consequently ready to proceed with the work immediately.

We must leave further details of these important stations until a more opportune occasion, which will occur later. But we cannot depart from the country without recalling some of its historical past and its literary traditions. For it is a land having, in its most characteristic regions, a year of but one day and night—the summer, a perpetual warm, sunlit day, filled with the aroma of trees and plants, and the rest of the year a night of darkness ; a land which is the extreme northern limit of European civilisation, on the outskirts of which the great primitive gods still dwell, and where elves and fairies and mermaids are still regarded, according to an expression of Jonas Lie, as "tame domestic animals." As one of the persons in Björnson's "Over Œvne" (Beyond our Strength) observes : "There is something in Nature here which challenges whatever is extraordinary in us. Nature herself here goes beyond all ordinary measure. We have night nearly all the winter ; we have day nearly all the summer, with the sun by day and by night above the horizon. You have seen it at night half-

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veiled by the mists from the sea ; it often looks three, even four, times larger than usual. And then the play of colours on sky, sea and rock, from the most glowing red to the softest and most delicate yellow and white ; and then the colours of the Northern Lights on the winter sky, with their more suppressed kind of wild pictures, which are for ever full of unrest and for ever changing. Then the other wonders of Nature ! These millions of sea-birds, and the wandering processions of fish, stretching for miles ! These perpendicular cliffs that rise directly out of the sea ! They are not like other mountains, and the Atlantic roars round their feet. And the ideas of the people are correspondingly unmeasured. Listen to their legends and stories ! "

These characteristics are less evident perhaps in and around Stavanger than in the northern parts. The old town, one of the principal centres of the country, is the first to be visited by tourists from the British Isles. It is situated on the coast of the Bukkenfjord, which is the most southerly of the many beautiful inland gulfs for which Norway is so deservedly famous. The broad basin of water is studded with many islands, and its arms extend inland in every direction, some with smiling shores, others flanked by high hills. The city is one of the oldest in Norway, and possesses a population of some 35,000, which makes it the fourth largest township in the country. Its most notable feature is the Cathedral of St. Swithin, for it is the only remaining example of a style of architecture which flourished before the twelfth century. All Norway's oldest buildings are the churches, which took the place of the early heathen buildings known as " Hov." Such buildings are of two distinct types, though both are developed on Norman lines, but adapted to allow the greater use of wood as building material. The churches of the North and West were richer in varied treatment of detail than the Southern buildings. All the churches, even the largest, are built without aisles and roofed with beautifully constructed timber. None of the older examples take the Basilica form, for it was not until after 1150 that this style was used in

A View of Stavanger Fjord.

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smaller buildings. The consequence is that St. Swithin's of Stavanger is the only perfect building of this kind extant to-day. In treatment of interior detail the church presents a striking resemblance to the Knights' Hall in Rochester Cathedral, which was built about the same time—that is, early in the eleventh century. The work of building was probably superintended by the first Bishop of Stavanger, an Englishman, Reinald, who had been a Canon in Winchester Cathedral. He therefore took that building as a prototype, and the dedication of the church to St. Swithin is to be attributed to the same circumstance, for the saint, who is supposed to have such influence on English weather, was Bishop of Winchester from 837 to 862 A.D. The building has twice suffered from fire, and is to some extent shorn of its splendour from these causes. Nevertheless, it is still a valuable asset to Norman architecture. Near it once stood the Episcopal Palace of Kongsgard, but the site is now occupied by the Latin School, for the seat of the bishopric was removed to Christianiassund in 1685. The change was due to the wishes of King Christian V., who, as ruler over a kingdom of which Norway and Denmark were units, wished the seat of Church government to be more central. A few years after the town was practically devastated by a disastrous fire, and Christian took the opportunity to cancel its charter in the hopes that it would not again be rebuilt and that the inhabitants would make new homes in Christianiassund. But for reasons which it is impossible now to discover, his kingly pleasure was disregarded, and the town gradually rose again into prominence. Many of the buildings then erected remain to-day, so that Stavanger, with its narrow streets and wooden houses, is a town beloved by the artist and by all who have an eye for the picturesque.

Even yet the national costume is worn by some of the older inhabitants, although it is gradually falling into desuetude, and for this the tourists are most to blame., for the influx of visitors has, to a great extent, modernised the town. Nevertheless, those who are on the look-out for old-world sights are sometimes rewarded. For instance, to see a *stolkjaerre*—that is, a light cart with seats for two persons—whirling along the dusty high road, behind a lean but active nag, which is frequenly driven by a *gut* of very tender years, brings to the spectator a sense of charm.

Old Tower at Ullenhaug, near Stavanger, in the neighbourhood of which the Transmitting Station will be erected.

But Stavanger does not rely merely on the tourist for its good report ; it is a fairly large centre of industry. Along the sides of the wharves are many factories which produce a variety of hermetically tinned and preserved cooked foods, especially sardines and anchovies. This industry is quite of recent date, but the exceptional advantages of position for the supply of raw material and facilities for reaching the world's markets are such that the large businesses of this kind number twenty-four, and others are inaugu-

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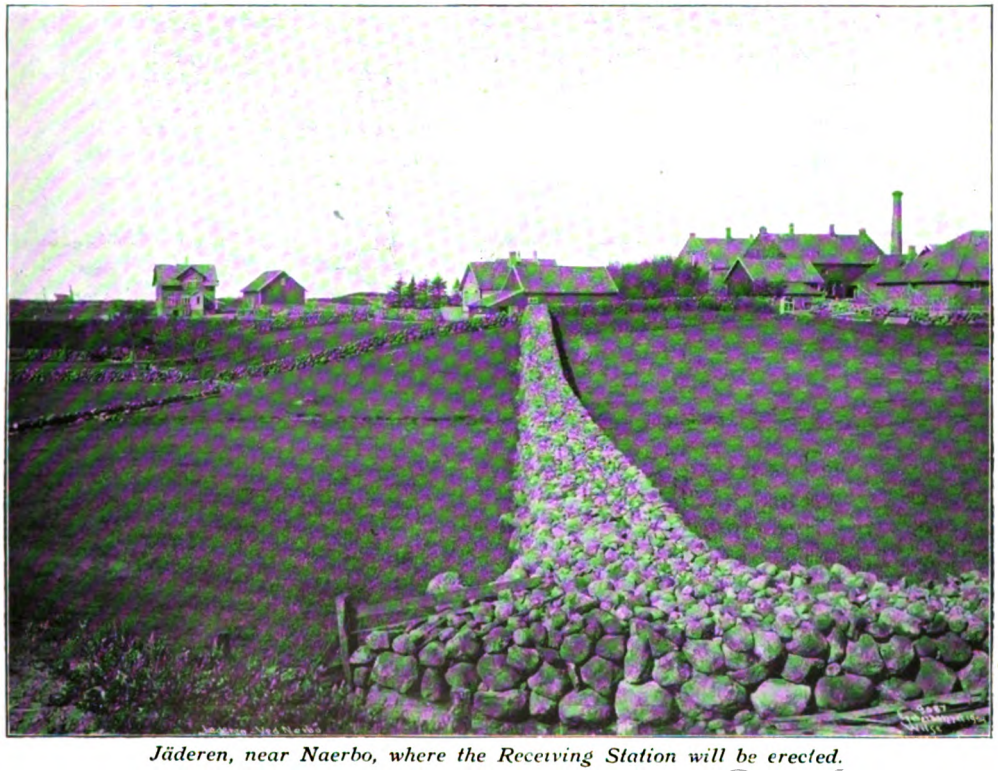
Interior of St. Swithin's Church, Stavanger.



Jäderen, near Naerbo, where the Receiving Station will be erected.

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rated almost yearly. Another flourishing industry is the extraction of iodine from seaweed, which all along the coast of Norway is abundant.

There are one or two famous views which deserve notice. The most noteworthy is from the Vaalandshang, which is typical of Norwegian scenery. But another and more extensive one is seen from the Ullenhaug, two miles outside the city. The hill is surmounted with a tower, the walls of which bear an inscription referring to a naval victory by Harold Haarfager off this coast in 872 A.D. Haarfager, or the *fair-haired*, it seems, had vowed a vow that he would not cut his hair until he obtained possession of the whole kingdom of Norway. The victory here commemorated was the ultimate event which gave him his great desire and released him from his vow. At his death the kingdom was again disunited, but subsequent events do not invalidate his claim to be the first king of United Norway.

It is here, as we have already mentioned, that the Marconi transmitting station is to be erected.

To get to Naerbo, which is some seventeen miles outside Stavanger, and which is to be the site of the Marconi receiving station, it is necessary to take train. The route crosses and recrosses the Ekersunds Elv, and then traverses a wide plain on the coast, finally passing through great tracts of moor and woods, with occasional glimpses of the sea, several lakes, and high masses of gaunt and barren rocks.

A tablet in memory of Jack Phillips, the wireless operator in the *Titanic*, was unveiled last month at Farncombe Church, Godalming, where Phillips formerly sang in the choir.

Capt. Thorwald Nielsen, who will be in command of the *Fram* when she takes Amundsen's party on their expedition to the North Pole, has informed the Norwegian *Aftenposten* that the vessel will carry a wireless station, and that he himself will take a course of instruction in wireless telegraphy.

Sætersdalen Highlanders with Pack Horse.

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The New Mercury.

[Poetry which has wireless telegraphy for its subject is still rare. On this account the following poem, which appeared in the *New York Sun*, is particularly interesting. It shows besides marked originality in both idea and expression.]

Dead priests that have sung when the world was young at Mercury's temple place,
Your myth, it was true—it is born anew in the death of time and space!

More swift, more fleet, than the sun-stained feet of the Dawns that trample the night—
More fleet, more swift, than the gleams that lift in the wake of a wild star's flight—
Through the unpathed deeps of a sea that sweeps unplumbed, unsailed, unknown,
Where the forces untamed, unseen, unnamed, have ruled from the first, alone,
Now the ghosts of thought, with a message caught from the tales of the dreaming past,
Unheard, unseen, with nor sound nor sheen, speed through the ultimate vast.

Battered and lamed and shattered and maimed, the liner crawls into port,
And the bolted tire and the volted wire are the toys of the whirlwind's sport,
And the gray sea's teeth in the depths beneath, where the coiled, green serpents play,
Are crumbling, crunching, mumbling, munching, at the cable lengths alway—
But now they may howl, the storms, and growl at the work of the lineman's hands,
For gone is their pride, with the boast of the tide that bit at the deep-sea strands;

For a sentience thrills through the bastioned hills that has neither voice nor form.
Nor recks of the might of the chaos-sprite who lashes the earth with his storm;
Bitted and bridled and shackled and girdled and bound with a linkless chain,
The brute powers cower at the god-like power that dwells in a human brain—
Man has stolen the wings of the deathless Things that range where the spirit is lord—
He is leagued anew with the silence through the strands of a strandless cord.

Where the moonmates dance to the sirens' chants on the floor of a level flood—
O'er the headland's crest and still fiord's breast that are dashed with the dead sun's blood
When the afterglows that are born of his throes coquette with the rising stars—
Through the shine and spray where the noonbeams play at painting a rainbow's bars—
Through the dripping shroud that the hurrying cloud flings over the stark berg's breast,
Unseen, unheard, leaps the Wraith of a Word, like a god on a god-like quest!

Man's feet are clay and they halt and stay with the graveyard worms and clods,
But his plum'd thought flings to the wind its wings in the haunts of the careless gods—
For those old gods live, and they weave and give new meanings to old myth,
And blossoms and gleams of the world-old dreams flower afresh from the truth at their pith—
So the tales that twine 'round the ruined shrine where the priests of Hermes sung,
They were true, they are true, they are born anew in the speech of a younger tongue!

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"Shock-Excitation" in Wireless Telegraphy

By GUSTAV EICHHORN, Ph.D. (Zurich).

WIRELESS telegraphy has passed into a new phase of development through the use of quenched sparks for the so-called method of "impact or shock-excitation." Its essence consists in using a very short-lived oscillatory discharge in a primary circuit to excite oscillations in an antenna arranged as a secondary circuit, the life of the primary oscillation being, in the ideal arrangement, just long enough to admit of the transference from primary to secondary of the maximum fraction of the initial energy—that is, the energy stored on the condenser in the primary circuit just before the beginning of its discharge. It may be mentioned that Prof. Braun made some attempt formerly to apply the same principle through the automatic stoppage of the primary circuit of oscillation after the energy has passed over to the secondary circuit (antenna), but he did not succeed on account of the artificial character of the means employed.

According to the theoretical investigations of Prof. M.Wien and Prof. P. Drude, it was considered preferable to keep the damping (consisting principally of spark-damping) in the primary circuit permanently as low as possible. Indeed, Prof. Wien found that in the case of loose coupling the decrement of the emitted waves could, under the most favourable conditions, be reduced to that of the primary circuit.

It is a well-known fact that under ordinary circumstances a pair of coupled circuits give rise to two so-called coupling-waves of different frequencies and decrements, which produce the phenomenon known as "beating"; in the time of a beat the oscillatory energy passes from the primary to the secondary and back again. This will appear clearer by a proper definition of the coefficient of coupling κ, viz., in case of isochronism of the coupled circuits ($\nu_1 = \nu_2 = \nu$, or $T_1 = T_2 = T$), and of strong coupling, through which the individual frequencies will be altered into ν_1' and ν_2', we have $\kappa = \frac{\nu_1' - \nu_2'}{\nu}$, *i.e.*, the ratio of the number of beats to the frequency of the oscillations gives the coupling-coefficient.

The real cause of this phenomenon lies in the special character of the wide spark-gap hitherto employed in the primary of the coupled circuits.

There remains always a certain amount of ionisation in the spark-gap, and therefore the resistance never obtains the required high value after a discharge, and also the tension produced by the reaction of the secondary system just reaches its maximum, so that a fresh excitation of the primary takes place. The energy is oscillating to and fro, and thus makes possible the generation of the two coupling-waves with the periods $T' = T\sqrt{1+\kappa}$ and $T'' = T\sqrt{1-\kappa}$, even if the individual frequencies of the two circuits are the same.

It is perfectly clear that this means a great waste of energy, firstly through the consumption of energy in the primary, and secondly because only one-half of the radiated energy is utilised in the receiving station.

In consequence of the reaction of the two circuits in the sender the decrement of the more feebly damped wave becomes greater, depending upon the degree of coupling; in other words, the possibility of sharp tuning becomes less.

All these well-known disadvantages of the ordinary method of coupled circuits have been eliminated through Prof. Wien's quenched sparks, *i.e.*, by employing very narrow spark-gaps instead of the former wide spark-gap. The characteristic feature in this case consists in using very different decrements in both circuits, that of the primary being much greater than that of the secondary. Of course, at the beginning the damping of the primary must also be very small in order to avoid waste of energy, but it soon increases. In this way, the energy, after it has passed over to the secondary,

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does not revert to the primary, but is oscillating in the secondary system only in the individual period of the latter, and is radiated by it. However, this great decrement in the primary would not of itself prevent the reaction of the secondary, but the essential feature of this method of "impact or shock-excitation" lies, as mentioned before, in the particular behaviour of the small spark-gap; it acts by de-ionisation as an interrupter, which disconnects the primary circuit from the antenna, after the latter has stored up the greater part of the energy. From this results the important advantage of the emission of wave-trains of only one frequency.* As necessary conditions for this impact excitation we may especially point out the following:

1. *Sufficient quenching of the spark-gap.*—This depends on the nature of the spark-gap and the spark potential, and can be accomplished either after the first beat or after a number of beats, the former being the better condition for good impact excitation.

2. *Sufficient duration of the first minimum.*—This depends on the closeness of coupling; the time of a beat being shorter with closer coupling, and therefore also the time, in which the current becomes nearly zero, when the de-ionisation can take place. Thus the better the quenching the closer can the coupling be made. Therefore, if the time of the de-ionisation is given, the coupling of the two circuits, and with that the time of a beat, must be regulated in such a way that the latter is just equal to, at any rate not smaller than, the time of quenching.

For *long spark*-gaps the quenching effect is small, therefore a relatively loose coupling is required; by inserting vacuum-tubes into the primary circuit the quenching effect can be improved, as was also first shown by Prof. Wien.

For *short spark*-gaps the quenching effect is good, therefore close coupling is possible. The new Telefunken-system, which is based on Prof. M. Wien's discoveries, works with a coupling-degree of about 20 per cent. By special devices Prof. Glatzel arrived at 40–50 per cent. coupling for an ideal impact excitation.

* In Braun's coupled circuits this was only attainable with a quite loose coupling, which is unfavourable for long distance work.

3. *Sufficient tuning of the coupled systems.*—The effect of putting the two systems out of tune has this effect, that the current-minima of the primary circuit cannot become zero, and consequently there is not much de-ionisation. The worse the quenching effect and the looser the coupling the more perfect must be the tuning of the coupled systems. This makes the working with long spark-gaps, in which the quenching effect is bad, inconvenient for practical purposes. On the other hand, the better the quenching effect the less exact need be the tuning between the two systems, and this has the advantage that the same antenna may be used for a large range of frequencies without being altered. For very good quenching, tuning and degree of coupling are in such relation to each other that, if one of these factors is not regulated to its best value, good impact excitation may be obtained again by altering the other factor.

The advantages claimed for the new method of impact excitation through quenched sparks can be followed in the original papers by Prof. Wien and in other articles published in the *Jahrbuch der drahtlosen Telegraphie und Telephonie.*

In this method, and by using detectors for integral effects, a musical note is produced in the telephone, and the system based on it is called "System der tönenden Löschfunken"—quenched musical spark system.

As already shown, Prof. Wien's method is not an ideal "shock-excitation," as the spark is not quenched directly after the first primary oscillation, but for an ordinary coupling-coefficient of, let us say, $\kappa = 0.16 - 0.20$, there are still a number of oscillations before the quenching takes place.

An ideal impact excitation is realised in a method which I had already devised ten years ago* for measuring instruments. A completely closed circuit, whose decrement can therefore be made infinitely small, is connected with a shunt in such a way that the inductance-coil is traversed by a weak direct current; by breaking the shunt instantaneously an extra-current is induced, which charges the condenser; very feebly damped oscillations are then set up in the closed circuit with magnified amplitudes in comparison to the potential-amplitudes of

* D.R.P. (German Patent) 157056/1903.

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the ordinary condenser-discharges. In this method an aperiodic process is concerned, which excites the oscillations and thus represents the ideal form of shock-excitation. The extremely small decrement of this device, which is now employed in all modern wavemeters and station-controllers (in case they are to play the rôle of a transmitter), allows all resonance-measurements of frequencies and of decrements to be made with a hitherto unknown exactitude. It is especially suitable for measuring wave-lengths at a distance. In my laboratory in Zurich, for instance, I found in this way the wave-length of the Eiffel-Tower station in Paris to be 2180–2185 meters, which is exactly the wave-length of this station measured in Paris itself, as I was afterwards informed by Commandant Ferrié, the Managing Director of this station.

Crystals as Detectors

A REPLY TO DR. TUTTON. By H. J. ROUND.

I HAVE read with great interest Dr. Tutton's paper on "Crystals." Is there not, however, a doubt whether what is usually called a crystal is a necessity for the production of a wireless detector of the rectifying type? I am aware that crystals, especially those found in nature, do act as detectors, but I can call to mind one or two substances which one would not call crystals, and which do act as rectifiers—carbon, for instance, is an example of this, and the amorphous carbon, used for arc lamp carbons, is decidedly better than either graphite or diamond—the two crystalline forms. Of course, carbon exhibits the rectifying power to a smaller degree than the crystals, but experiments I carried out a year or so ago on carborundum led me to try the oxides of calcium, barium, strontium, and the still more refractory rare earth oxides used in Nernst filaments. I found that, provided the necessary arrangements were made to keep these substances at the right temperature, rectifying effects as good as carborundum produces, could be obtained, and as wireless detectors they were equally sensitive. The "characteristic" of carborundum suggests strongly a Nernst conductor, with a "heater" in parallel with it, the characteristic of the heater being a straight line.

Possibly this "heater" accounts for the great differences in "characteristic" produced by different masses of carborundum, and it occurred to me that the "heater" was due to a conducting impurity, which roughly obeys Ohm's Law. The idea is partly upheld by two considerations.

Generally crystals from the same mass of carborundum exhibit characteristics which are similar.

The resistance is lower, the deeper the colour of the mass from which the specimen is taken.

I make no attempt to explain the unsymmetrical character of the characteristics for positive and negative currents. One curious thing, however, which has not generally been noted, is that black and gray carborundum in general have their best working point at about 1 volt $-ve$, metal contact, whilst green carborundum takes about the same voltage with the metal contact $+ve$, the best working point is always where the sharp bend from high to low resistance occurs, and is on the side where the characteristic is steepest.

It is not at all necessary to have a crystal point, face or edge; in fact, for consistency of adjustment, a broken point seems always preferable, although the average resistance seems higher, and consequently higher potential circuits have to be used in practice.

I have not tried other crystals to any great extent, but as a usual thing the last statement is generally true. Iron-pyrites, it has been generally noted, gives the best, or at least the easiest obtained good results on a cleavage surface.

The fact that crystals work well as wireless receivers suggests strongly to me that a definite composition is necessary, and not so much a crystal character. If the definiteness of composition remains throughout the whole mass, the wireless operator has many opportunities of hitting a good point—and this condition is undoubtedly best given by a crystal.

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Application of Wireless Telegraphy to Time Signals

By COMMANDANT FERRIÉ.

The following is an abstract of a paper read before the Joint Meeting of the Institution of Electrical Engineers and the Association Internationale des Electriciens in Paris on May 24th, 1913. See article in the "Year Book of Wireless Telegraphy and Telephony," 1913, by Mr. A. R. Hinks, F.R.S., for complete information on the subject.

A KNOWLEDGE of time to an accuracy of a few tenths of a second suffices in the great majority of cases, and in particular for navigators, for business purposes, and for the general public. The method of transmitting the signals is then quite easy. At the Paris Observatory and the Eiffel Tower the method now adopted is as follows :—The true hourly signals are comprised of "dots," or series of sparks, lasting about a quarter of a second, which are sent out at fixed hours—viz., during the day at 10 hours 45 minutes, 10 hours 47 minutes, and 10 hours 49 minutes; and during the night at 11 hours 45 minutes, 11 hours 47 minutes, and 11 hours 49 minutes. Each of these "dots" is preceded by a series of preliminary signals with the object of calling the attention of observers and of allowing them to adjust their receivers. In order that the true hourly signals—*i.e.*, the dots—should be produced as exactly as possible at the desired instants, the following arrangements have been adopted :—

Arrangement at Eiffel Tower.

A special clock in the observatory is provided with an electric contact, which is closed automatically for a quarter of a second at each of the above-mentioned times. This contact is connected by means of an underground cable to a relay controlling the transmitter in the wireless station at the Eiffel Tower. In addition, a Morse key placed near the clock allows the preliminary signals to be produced. A short time before the sending out of the day and night signals the astronomer sets his clock, after having compared it with the master clock of the observatory, the transmitting apparatus is connected to the relay, and the sending out of the signals is effected in the manner described above. The lag due to the mechanical and electrical inertia of the various apparatus between the instant of making contact by the clock and the passing of the wireless spark is measured periodically with great care, and allowance is made for this at the instant when the signal is sent.

The Paris International Conference decided that from July 1st, 1913, the sending of the signals shall be made in a uniform and entirely automatic manner by all the radiotelegraphic stations undertaking the service at predetermined times (differing for each station), the wave-lengths also being uniform (2,500 metres). The Eiffel Tower, which was chosen as the centre of the international time-service, will send its signals at 10 a.m. and at midnight. The morning signals will be made in the following manner :—

A series of warning signals, consisting of the sign for letter "x" (— . . —), will be sent from 9 hours 57 minutes to 9 hours 57 minutes 50 seconds, and this is followed by a period of silence of 5 seconds. From 9 hours 57 minutes 55 seconds to 9 hours 58 minutes, three dashes lasting one second each, and separated from one another by periods of silence also lasting one second, the end of the last dash terminating at 9 hours 58 minutes exactly. During the following minute the letter "n" (— .) is sent five times, the dash lasting one second and the dot a quarter second, the interval between the dot and the dash being also one second. Each of these letters is commenced respectively

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at 9 hours 58 minutes 8 seconds, 9 hours 58 minutes 18 seconds, 9 hours 58 minutes 28 seconds, 9 hours 58 minutes 38 seconds, and 9 hours 58 minutes 48 seconds; the dots therefore commence on the round 10 seconds —namely, 10 seconds, 20 seconds, 30 seconds, 40 seconds, and 50 seconds. Three dashes similar to those of the preceding minute also terminate the second minute in such a way that the third dash terminates at 9 hours 59 minutes. During the third minute the letter "n" will be replaced by the letter "g" (— — .), of which the dots, the dashes, and the intervals shall last the same time as in the case of the letter "n," the "g" signals beginning at 9 hours 59 minutes 6 seconds, 9 hours 59 minutes 16 seconds, 9 hours 59 minutes 26 seconds, 9 hours 59 minutes 36 seconds, and 9 hours 59 minutes 46 seconds, the dots of these letters falling on the round 10 seconds as in the case of the n's. Finally, this third minute will finish with three dashes similar to those of the preceding minutes, the last dash terminating at 10 hours.

How to Receive Hourly Signals.

For receiving these hourly signals, termed "ordinary," it is only necessary to have the antenna, of dimensions and height varying according to the distance from Paris, connected with a radiotelegraphic receiver, and to listen to the signals, with the clock or watch to be compared in front of the observer. It is easy for an unskilled person to estimate the difference up to half a second between the hours indicated by the clock and those which correspond with the signals that are heard in the telephones of the receiver. After some practice it is quite easy to estimate one-quarter of a second. In order to reach an accuracy of one-tenth of a second, it is in general necessary to have recourse to simultaneously recording on the same photographic strip the radiotelegraphic signals and the beats of the clock to be compared. Excellent results have in this way been obtained by various physicists and engineers. It frequently occurs, especially in winter, that the Paris observatory is not able to make astronomical observations each night. It is therefore necessary to be satisfied with the times registered by the chronometers of which the rate is known for the setting of the clock which sends the signals. These chronometers, being sufficiently numerous and accurate, cause no inconvenience so long as the cessation of astronomical observations does not exceed a few days. If, on the other hand, the period of cloudy weather continues too long, it is no longer possible to answer for the accuracy of the chronometers. Wireless telegraphy in such cases furnishes a method which allows of the co-operation of other observatories, better situated as regards climatic conditions, in the determination of the state of the master-clock at Paris, and in consequence in the accurate setting of the clock which sends the signals.

Ordinary Night Signals.

Before the ordinary night signals the Eiffel Tower sends a series of 180 short "dots" regularly spaced by one second, less about 1-50th. In each series the 60th and 120th "dot" are suppressed in order to facilitate counting by the observers. These "dots" are produced by substituting for the Observatory clock sending the signals a small clock of adjustable rate and furnished with an electric contact which closes at each complete swing. This series of dots is received, by means of a radiotelegraphic installation, by the Paris Observatory and by other observatories, in each of which an operator, by means of a suitable arrangement, listens to the series of "dots" and also to the beats of the master-clock or of another seconds chronometer. The two regular series of dots thus perceived by the Paris Observatory, for example, constitute an acoustic vernier, and during the time that the 180 radiotelegraphic "dots" last, three coincidences spaced 50 seconds apart occur between the radiotelegraphic "dots" and the beats of the clock. By noting the time indicated by the chronometer at the moment of coincidence, as well as the number of the radiotelegraphic beats at which the coincidence occurs, it is easy to calculate the time of the chronometer at the instant of the first beat of the radiotelegraphic series. If the time (Greenwich mean time) of a coincidence was, for example, 23 hours 30 minutes 25 seconds, the number of the stroke and coincidence being 42, the time of the first beat must have been 23 hours 30 minutes 25 seconds – 41 $(1 - \frac{1}{50})$ seconds = 23 hours 29 minutes 44·82 seconds.

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The observer at Algiers, for example, proceeds in the same manner, and determines, after allowing for the state of his chronometer and of the difference of longitude of Algiers, 23 hours 29 minutes 44·13 seconds for the time (Greenwich mean time) of the same first beat. These figures are at once telegraphed by wire to the Paris Observatory, followed by the note "observed" when the Algiers Observatory has been able to make astronomical observations for the determination of the state of its own chronometer. The observatories at Marseilles, Nice, Besançon, etc., do the same. Paris is therefore able to determine the state of its master-clock by utilising in reality all the astronomical observations made by all the provincial observatories. The signals sent out have therefore the maximum accuracy now attainable.

Scientific Time Signals.

The Paris International Conference, October, 1912, has decided that the sending of these series of beats, which it has termed "scientific time-signals," shall be preserved in the international organisation of time service, and that the foreign observatories shall co-operate also, as far as possible, in the same way towards the improvement of the time transmitted by the international time centre of Paris.

By the same method it will be possible to realise the practical unification of the time sent by the different radiotelegraphic stations engaged in the international time service. In each of these stations the scientific time signals sent each evening by the Eiffel Tower will be received and compared with the beats of the master-clock of the observatory with which the station is connected, and on each occasion the time of the first beat will be worked out from the master-clock. As the Eiffel Tower sends, after the ordinary night signals, figures indicating the time of the first scientific signal preceding the latter, each of the other radiotelegraphic time stations will know the amount of correction to be applied to its own time, and will thus be able to take this correction into account for the next subsequent emission of time signals. This practical standardisation has many advantages, especially for mariners sailing within the zone of action of two stations or passing from one zone to another, as they will no longer, as now happens when checking their chronometers, suffer from the uncertainty that arises due to two stations emitting signals which differ by half a second or even more.

The same method also enables land surveyors and astronomers to compare to an accuracy of $\frac{1}{100}$th of a second the time-measuring instruments placed at two or more points of the earth's surface within the zone of action of the same station, and thereby considerably facilitates the determination of differences of longitude.

Calculating "Beats."

It is sufficient, by means of astronomical observations at each point, to determine the difference between the local time and that of the time-measuring instrument, and, taking into account this difference and the rate of working, to calculate the time of the first beat of a series of signals sent by the station, in the same manner as in the case of scientific time-signals. To secure greater accuracy in the comparisons the beats are in general at intervals of about $(1 - \frac{1}{100})$th of a second. When the signals are made in summer-time in hot countries, where natural electric disturbances are intense, it is necessary to substitute dashes for radiotelegraphic dots, as the former are more easily observable through the disturbances, especially when musical sparks are used. At the same time it must be pointed out that the accuracy of coincidence, which is then in respect of the beginning of the dash, is not as good as in the case of dots, especially when the ear only is relied upon. It is likely, however, that the accuracy will be appreciably increased when the signals are photographically registered.

It has already been possible by means of wireless telegraphy to determine the differences of longitude between Paris and the following places:—Brest, Bizerta, Brussels, Algiers, Toulouse, and Nice. In the delimitation of the Franco-Liberian and Franco-German frontiers in the Congo now being carried out, use is made of wireless telegraphy for the determination of the longitudes. Numerous points have been determined in the same manner in Morocco by the Army Staff by using solely the scientific signals emitted nightly from the Eiffel Tower. It is easy to foresee the important

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services which this method will ultimately render in the surveying of Central Africa and of similar parts of the globe which are difficult of access, and where ordinary surveying methods cannot be used.

FUTURE DEVELOPMENTS.

When the large wireless systems now under consideration by the Great Powers, and especially by France, Great Britain, and the United States, have been established, it will be possible for the continents to be connected with great accuracy, and also to include some of the more distant islands, of which a large number are at present only imperfectly connected, and by means of wireless telegraphy to encircle the globe for the determination of the differences of longitude between intermediate stations.

France and the United States have already resolved to determine by means of wireless telegraphy the difference of longitude between Paris and Washington with the greatest accuracy now attainable. Preliminary observations were made last March with the object of getting an idea of the difficulties of such a determination, and of laying down a programme of final operations. Notwithstanding the somewhat low powers available at the French and American stations (Eiffel Tower, 50 kw.; Arlington, 60 kw.), and the great distance apart (6,000 km.), it has been possible to make numerous observations in both directions in spite of the serious difficulties caused by the powerful disturbances of all kinds which interfered with the tests. It was even possible on one occasion (one night out of twelve) to carry out a complete conversation between the two stations. A first approximation of the difference of longitude, to an accuracy of a few 100ths of a second, will shortly be published, after the completion of the astronomical calculations. The final observations will probably be made during the winter of 1913–14.

It is interesting to note that in the case of long distances, such as that between Paris and Washington, it is essential to take into account the time necessary for the transmission of the impulse. On the assumption that the velocity is the same as that of light —namely, 300,000 km. per second—the time required for the transmission of the signals from one station to another is 0·02 of a second, which is not a negligible quantity.

EFFECTS OF AIR AND WATER ON WAVE TRANSMISSION.

Special experiments are under consideration for the direct measurement of this time of transmission. Various methods will be employed, and among others the following:—Short signals will be sent, alternately, per group of four, two each from the Eiffel Tower and from Arlington, with the shortest possible intervals of time; for instance, ten seconds between two consecutive signals. These four signals will be recorded in Paris and in Washington by means of photographic galvanometers with a rapid and uniform swing, simultaneously with the vibrations of a tuning fork, which will be used to measure the time. It is probable that it will thus be possible to determine with accuracy the 1–1,000th of a second, and that this will enable the observers to determine the speed of transmission to two significant figures. This may lead to some interesting results in connection with the respective effects of air and water on wave transmission between the old and the new continents, since the velocities are functions of the index of refraction.

It will be seen that the application of wireless telegraphy to time signals is of considerable interest from the practical as well as from the scientific point of view, and we must congratulate ourselves on the results of the International Conference held in Paris in October, 1912, on the initiative of the Bureau des Longitudes, by means of which the co-operation of the efforts of the scientists of all nations has been secured for the benefit of science.

The lengthy proceedings before the Select Committee considering the Imperial Wireless Scheme, occasioned a great deal of interest among amateur statisticians. The committee sat for two months—putting all their days of work on end—and the talk to which they listened fills 1,500 pages of closely-printed foolscap. In round figures, 30,000 questions were asked and answered in at least a million and a half words. By way of comparison, the Bible contains less than a million words.

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The Application of Wireless Telegraphy to Ships' Lifeboats

Summary of Evidence given on behalf of the Marconi Company by Mr. G. E. Turnbull before the Boats and Davits Committee.

THE solution of the problem indicated in the title of this article calls for careful thought, not only by those actually engaged in wireless telegraphy, but also by shipowners, shipbuilders, and by others responsible for the drafting of regulations concerning life-saving appliances at sea. In fact, an efficient result can best be arrived at by all these bodies in consultation with each other. There is nothing insurmountable, but there are several points of view which must be understood by all concerned.

Having regard to the size of the wireless apparatus which can be recommended, and the conditions which will govern its use in lifeboats, the complete equipment must clearly be as light and compact as possible, and must be of robust construction. It must be self-contained, always ready for use, and its component parts must be so arranged as to allow of easy access for inspection and maintenance.

The number of sets which it would be useful to place on board a ship depends of course upon the number of persons who would be capable of operating the sets, and to a certain extent upon the modifications which may be under consideration regarding life-saving appliances generally.

The distance over which the set is required to work should, of course, be as great as possible. The range, however, depends more than anything else, in the case of small equipments of the kind that will be required here, on the aerial wires which could be utilised.

It goes without saying that in the application of wireless telegraphy to lifeboats due consideration must be given to it in the ship's regulations, and in the boat drills.

THE APPARATUS.

In designing wireless telegraph apparatus to communicate for a specified purpose over given distances, the principal factors determining the form which the apparatus and its accessories should take are:

1. The height and extent of the aerial wire which can be arranged, and the facilities for its erection and maintenance.
2. The space available for the apparatus and the maximum weight admissible.
3. The electric power in the form best suited for the apparatus, and to the communication the latter is to be capable of effecting.
4. The general conditions under which the apparatus is to work.
5. The training of the persons who are to work the apparatus.

The Marconi Company have constructed and disposed of for military purposes a number of small portable stations, capable of communicating some seven to ten miles over land. The sending and receiving instruments are contained in two separate boxes. The receiver weighs 6½ lbs., and the transmitter 12 lbs. The battery to operate the transmitter is carried in a separate box weighing 13 lbs. All three boxes can be very conveniently carried by one man.

The masts supplied in conjunction with this set may be of the telescopic type, or may be made up of aluminium, steel, or wooden sections. Using one mast of from 25 to 30 feet in height, this small station is capable of working approximately fifteen miles over water and seven miles over land.

This set admirably fulfils the purpose for which it was designed, but it is not altogether appropriate for lifeboat use. The Marconi Company have therefore designed a special

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lifeboat set. As the same considerations of lightness do not apply so much here as in the portable set already referred to, the Company have been able to provide more power in the transmitter, and to make provision against the sea atmosphere and bad weather conditions.

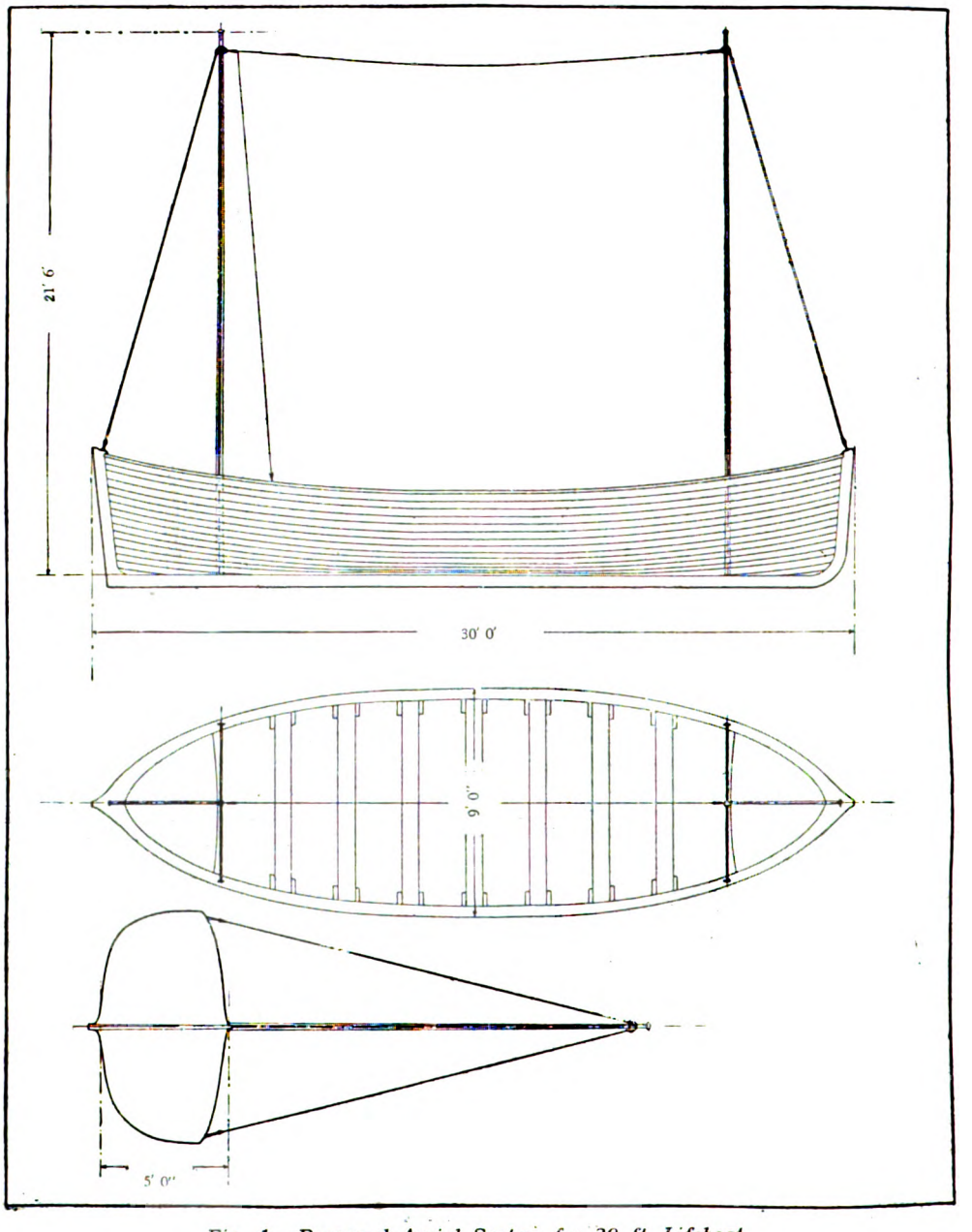

Fig 1.—Proposed Aerial System for 30 ft. Lifeboat.

The electric current, which in the portable set is derived from a small battery, is in this case supplied by a hand-driven magneto

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machine which can be relied upon to work for several years without requiring to be re-magnetised. Where the wireless apparatus is used is so intimately bound up with, and dependent upon, the amount of aerial wire which can be suspended, that the size of

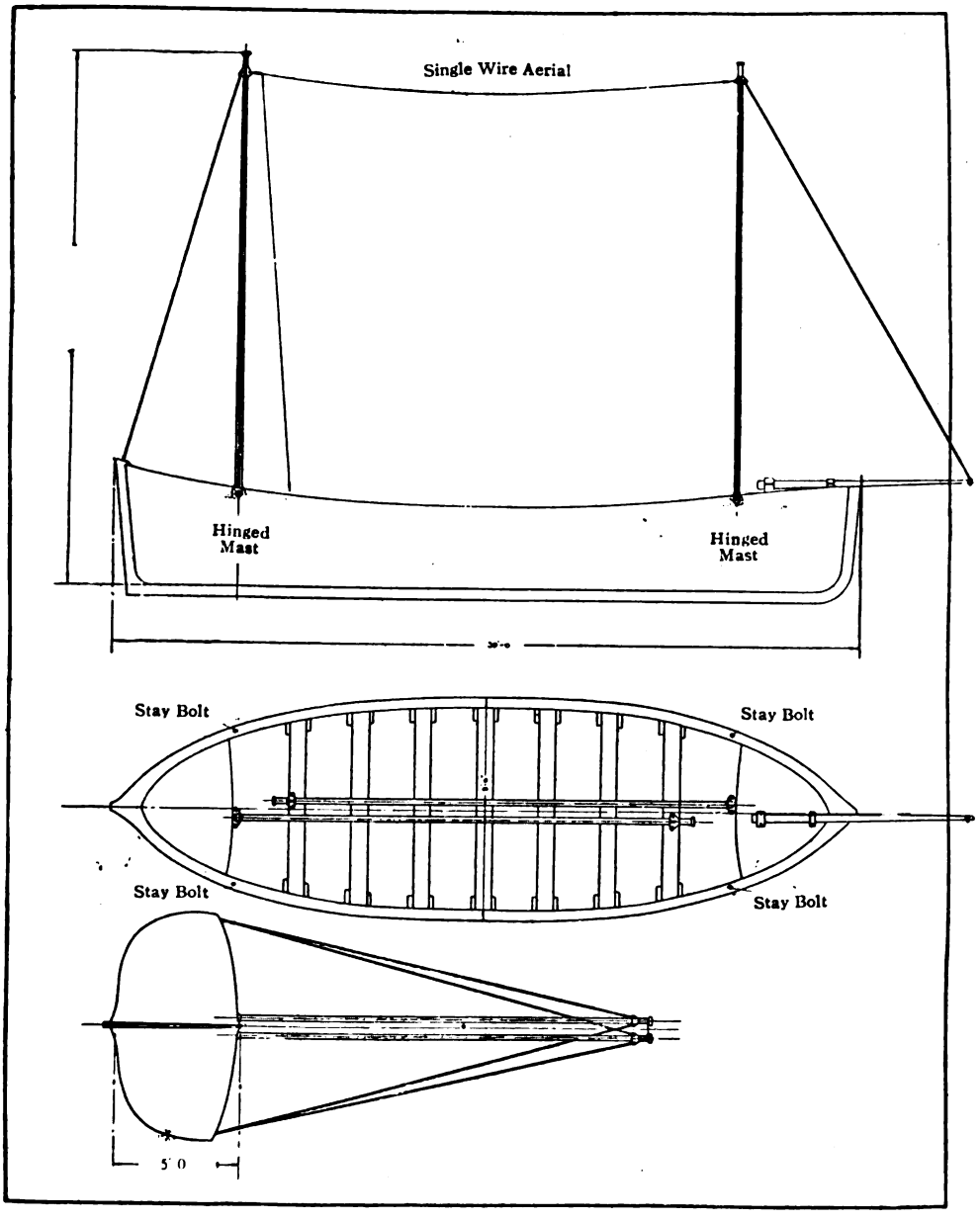

Fig. 2.—Masts hinged to framework of Boat.

to be used in a lifeboat provided with motive power, this magneto can be of a larger size and driven by the engine. The question of the amount of battery or dynamo power to be the battery or dynamo is quite secondary, especially as these things either exist in various descriptions, or can be made at very short notice to almost any size and shape.

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The question of aerial wires is important, and calls for the most careful consideration of what has happened in the past in regard to the launching of boats, and the distribution of passengers in them, and also of what is likely to occur with new arrangements and regulations which may be contemplated for the future. It will no doubt help to an understanding as to the practicability of one type of aerial suspension as against another if we make some reference here to the consideration of aerial design in wireless stations of the three following categories: A fixed land station; a ship station; a portable land station.

In the case of a fixed land station where a sufficient area is generally available, and where masts can be erected at a height and distance between them at will, the aerial wires are arranged as far apart and as high as possible consistent with economy in mast height and number of masts. There are, of course, formulæ, established by experience, which decide the best size of aerial for a given power and a given range, but as a general rule it may be said that the range with a given power is proportional to the height of the masts and the distance between them.

In the case of a ship station, the extent of the aerial is limited by the distance between the masts and by the height of the latter, so that to obtain the maximum possible transmitting range of a ship station, more power in proportion to the size of the aerial has to be utilised on board ship than need be at a fixed station on land.

In the case of a portable station, a maximum height has to be arranged for, with due regard to the necessity for lightness and facility in transport. As a rule, therefore, masts made up of sections of wood, or of tubular steel or aluminium, are used for portable land stations. Generally speaking, portable apparatus is required for military purposes, or for the survey of unexplored districts, but in both cases the distances at which masts can be set apart are not limited by space so much as by the span over which the aerial wire can support its own weight with a sufficient margin of security. The possibility of erecting a large aerial by spacing the masts as far apart as practicable is therefore fully taken advantage of.

Having briefly examined these three cases, it will be clear that the principal factor to be considered in applying wireless telegraphy to lifeboats is the dimensions and arrangement of the aerial wire which it is possible to rig. Considering that the lifeboats must be swung out from the davits free of obstruction, that they may have to be launched fully occupied, and that the wireless equipment must be in working order as soon as possible after the boat reaches the water, the method of suspending the aerial should therefore be such as to admit of rapid erection. We have set out in the accompanying sketches, Figs. 1 and 2, two methods of aerial suspension by means of masts. The mast shown in Fig. 1 may be stored on the boat itself or at a convenient point on the deck and stepped in the boat after it is launched. Suitable sockets are provided in which the masts are stood, each mast being stayed by means of three hook-on stays. The mast may be in one piece or made up in sections. In Fig. 2 the aerial is suspended from two masts, hinged permanently on the framework of the boat.

It is a matter to be considered by mariners which of these two systems is the more likely to be easily manœuvred and fixed in position with a boatload of passengers.

In Figs. 1 and 2 we have indicated a normal mast height, though it is quite possible that boat designers will be able to provide a greater height than that shown. As we have already mentioned above, the greater the height the greater will be the range, and as we think this question of the most desirable mast system should be studied out thoroughly by boat builders, we have prepared another sketch, Fig. 3, showing approximately the advantages in the way of increased range which can be expected by providing extra height.

Two other means of supporting an aerial have been suggested—viz., one by means of a kite and another by means of a buoy, towed by the lifeboat at, say, 100 feet from the latter, and carrying a pole of 25 to 30 feet, or even higher. Kites are not suited for reliable communication at all times, owing to varying wind pressures, and the lack of constancy in the strength of signals occasioned by a continuously varying average height of the wire is not conducive to the best results. This is particularly the case when the maximum range of a station

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is being attempted. We are not prepared to recommend the exclusive use of kites, but it may be well to have them as a stand-by. Under favourable wind conditions, and with hands practised at kite-flying, a greater range could be covered than with the masts. Further, assuming that only a certain number of boats be provided with masts, kites might be used in the remote event of it being necessary to place wireless sets in boats not provided with masts or with their fittings.

Fig. 3 also shows the ranges which could be covered by suspending the aerial from a kite.

With regard to the possibility of providing a suitable aerial by a method under which a buoy towed by the lifeboat and carrying a pole, the aerial wire descending from the top of the pole to the boat at an acute angle, such an arrangement would present the advantage that the mast and its rigging would not encumber the boat, and any difficulty which might arise in fixing the masts with a boat full of passengers would be obviated. The same attention would not be required as for a kite, but there would be decided disadvantages in bad weather. More complicated compensating devices would have to be arranged to take up the "sag" and relieve the strain in the aerial owing to the swaying of the pole than would have to be arranged in the case of the kite.

The mast method seems the most reliable. All the lifeboats on the vessel could be fitted to take these masts, but the ship need not carry more pairs of masts than the number of wireless sets which it is found advisable to put on board.

OPERATING.

The majority of liners nowadays carry two operators, or one fully-licensed operator and one assistant who has passed a junior examination and is not yet fully certificated. In case of accident the chief operator would be required to stand by the ship's wireless station until ordered by the Captain to leave, but the second operator could be detailed at once for duty in one of the boats carrying a wireless outfit. It would have to be left to the Captain to decide when the chief operator was to leave the ship and take charge of the wireless equipment in another of the lifeboats.

There should, we think, be at least one wireless lifeboat equipment for each operator carried by the ship. As we have shown above, in the majority of cases this would mean two lifeboat equipments per ship. One of these might be appointed for the starboard side, another for the port side, or, as we have previously suggested, every one of the boats might be provided with the accessories to take the masts; each of these sets might be put into a particular boat determined by the Captain, according to the circumstances. If it is found desirable that there should be more than one lifeboat set per operator on each ship, then it would be necessary to provide for instruction in wireless operating of the ship's officers. From the navigating and engineering staffs there will always be on every ship a certain number of men who can be relied upon, failing the operator, to operate these lifeboat sets efficiently. As the sets will be of the most simple pattern, the handling can be learnt in a few hours. A sufficient instruction in the Morse code, and in the transmission and reception of wireless signals, will be the chief object to be attained. Many ships' officers already have a knowledge of the Morse code, so it should not take them very long to be capable of sending out, with the lifeboat set, a message indicating the position of the boat, its name, and a request for assistance; and further to distinguish, what an automatic transmitter could not do, that is, whether the line is clear or not, and whether they were not preventing communication between a lifeboat worked by one of the trained operators and a ship coming to their assistance. It could be arranged that one of the operators give for a short period every day on board instruction to officers in the use of these sets, and maintain or improve their standard of working. Even if there is only one operator on board, and only one lifeboat wireless set, it is desirable that two or more persons in addition to the regular operator should have sufficient knowledge in the working of these small sets. While it is, of course, desirable that the officers should be as efficient as possible in the handling of this apparatus, by no means the same standard of efficiency is required as for working the ship's main installation. The proposal, therefore, does

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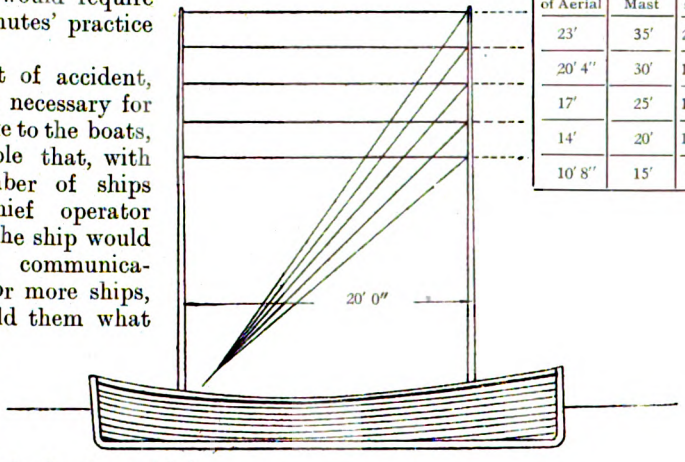
not mean difficult studies for persons who are not trained operators, for, providing their hearing is good, and they can accustom themselves to detecting wireless signals in a telephone, they should achieve a sufficiently high standard of proficiency in a few months. To maintain that standard would require only a few minutes' practice per day.

In the event of accident, and of it being necessary for everyone to take to the boats, it is conceivable that, with the large number of ships fitted, the chief operator before leaving the ship would have been in communication with one or more ships, would have told them what had happened, and every ship within hearing, after the chief operator's departure from the boat, would be listening attentively for wireless calls from the lifeboats. All wireless stations in the vicinity would be advised, so that everyone of them would arrange their communications in such a way that the calls from the lifeboats should have every possible attention.

SHIPS' REGULATIONS.

Provision must be made regarding the handling of the wireless boat-sets at drill. A certain number of hands would have to be instructed in the rigging up of the aerial. If it were decided to place the wireless sets in specially-appointed boats, the number of persons to be instructed in the erection of the masts and rigging up of the aerial will naturally need to be less than those who will have to be instructed if it is agreed that all the boats shall be arranged so that the sets of apparatus and masts may be placed in any one of them. Once these principles are decided, the question of proper instruction in drill becomes very straightforward.

Average Height of Aerial	Height of Mast	Distance Knap-sack Set	Distance Magneto Set
23′	35′	20 miles	25 miles
20′ 4″	30′	18 ,,	22 ,,
17′	25′	15 ,,	19 ,,
14′	20′	12 ,,	15 ,,
10′ 8″	15′	9 ,,	11 ,,



Average Height of Aerial	Height of Kite	Distance Knap-sack Set	Distance Magneto Set
75′	150′	65 miles	81 miles
62′ 6″	125′	54 ,,	67 ,,
50′	109′	43 ,,	55 ,,

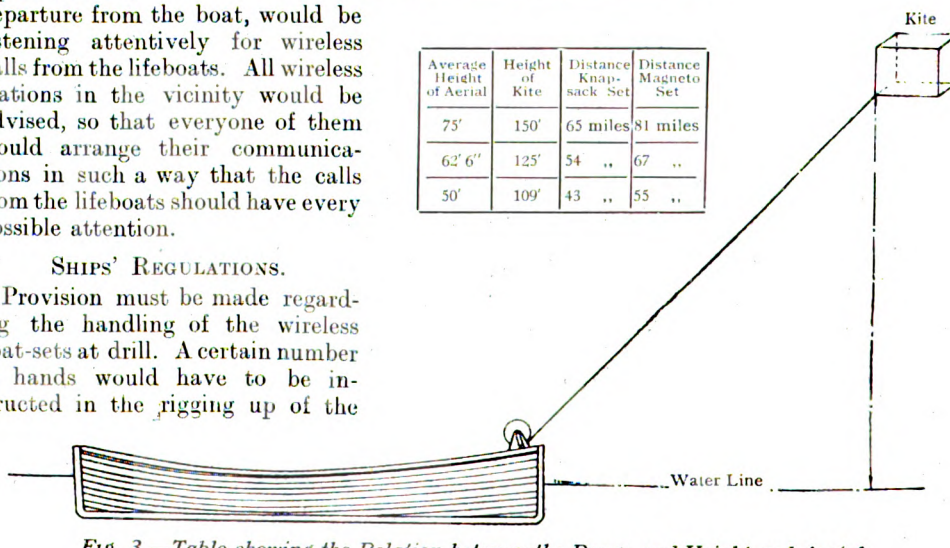


Fig. 3.—Table showing the Relation between the Range and Height and Aerial.

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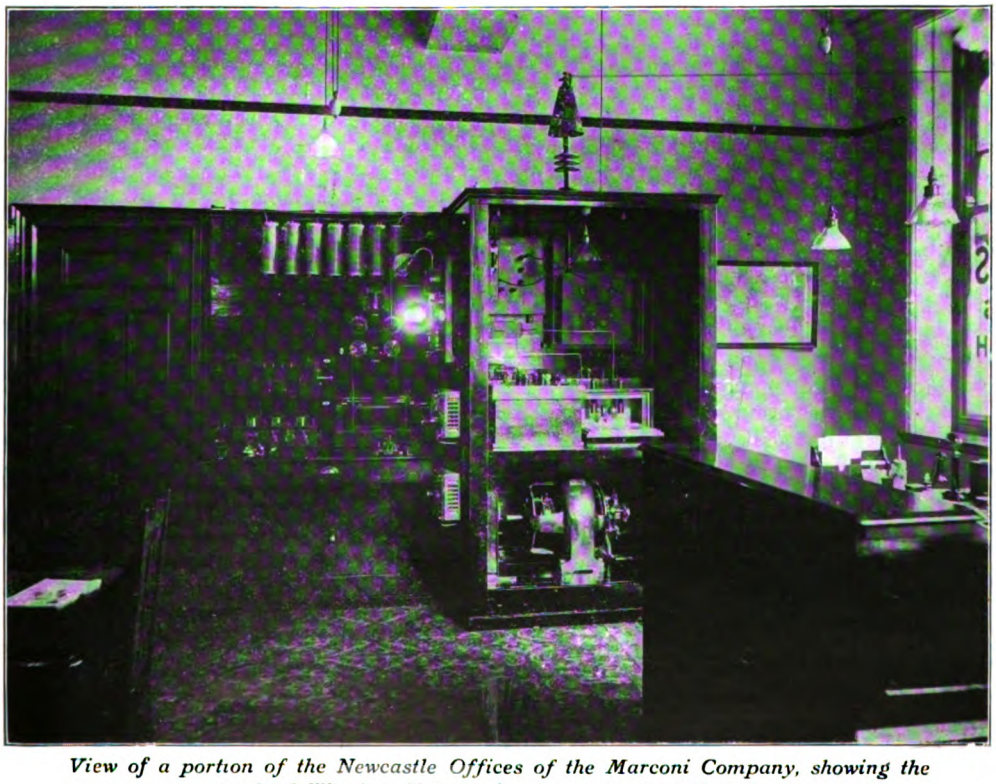
WIRELESS ON TYNESIDE

A LARGE company of shipowners and others interested in shipping on Tyneside visited the Newcastle-on-Tyne offices of the Marconi International Marine Communication Co., Ltd., at Milburn House on July 10th, and inspected the wireless station which the company have installed there. An explanatory address was given by Mr. Close, the local representative of the company, who later gave a demonstration of the working of the apparatus, and succeeded in communicating with various stations. The intention of the Marconi Company is to use this office in Newcastle for demonstrations to shipowners or others who may be interested or wish to use wireless telegraphy. The station is of the standard 1½-kw. type, employed on the majority of steamers equipped with wireless telegraphy.

The Portuguese Parliament passed a Bill on June 25th for the compulsory installation of wireless telegraphy in Portuguese ocean-going steamers.

The annual meeting of the British Association for the Advancement of Science will be held in Birmingham this year. The inaugural meeting will be held on Wednesday, September 10th, when Sir J. Oliver Lodge will assume the Presidency and deliver an address. In the engineering section (G), over which Prof. Gisbert Kapp will preside, papers have been promised by Prof. Marchant on "Some Effects of Atmospheric Conditions on Wireless Signals," and by Prof. G. W. D. Howe on "The Nature of the Electromagnetic Waves employed in Radio-telegraphy and the Mode of their Propagation." The meetings will conclude on September 17th.

The Budget Committee of the French Chamber has approved a report in favour of the adoption of a Bill ratifying the International Wireless Telegraphy Convention of London, 1912.



View of a portion of the Newcastle Offices of the Marconi Company, showing the standard Wireless Telegraphy apparatus installed there.

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THE IMPERIAL WIRELESS SCHEME

EXIT THE SELECT COMMITTEE. TERMS OF NEW CONTRACT OUTLINED. QUESTIONS IN THE HOUSE OF COMMONS. FURTHER OPINIONS OF EXPERTS.

THE past month has witnessed a decisive turn of events in connection with the Imperial wireless scheme. The Postmaster-General attended a meeting of the Select Committee of the House of Commons on July 2nd, and explained that the Government admitted that the Marconi Company were legally entitled to repudiate the contract signed in July, 1912, whereupon the Committee decided that as the agreement was not to be enforced it would be unnecessary to pursue their inquiries further. On July 4th Mr. Samuel made a statement in the House of Commons regarding a new contract with the Marconi Company for the Imperial wireless chain.

In the course of his statement to the Committee, Mr. Samuel said that the Government were advised that the contract was not valid unless it was ratified by the House of Commons, and the question arose whether, one of the parties to the contract having repudiated it, the Government could properly ask the House of Commons to ratify the contract with a view merely to litigation with the other contracting party. Further, said Mr. Samuel, if it were ratified, the Government were advised that it was not a contract with respect to which a Court would order specific performance.

Mr. Samuel was also prepared to state the further intentions of the Government, but objection to this was taken by members of the Committee, on the ground that it did not come within the terms of reference. The Committee considered the question in private, and the Chairman afterwards announced that the following resolution had been passed :—

> The Committee having been informed that Marconi's Wireless Telegraph Company, Ltd., have repudiated the agreement entered into between Marconi's Wireless Telegraph Company, Ltd. (Commendatore Marconi) and the Postmaster-General, and having heard from the Postmaster-General that he is not prepared to enforce the agreement, are of opinion that, as the agreement which formed the subject matter of the reference to it is not to be enforced, it is unnecessary for it further to pursue its inquiry, and it so reports to the House.

In thanking the Committee for the information given to him, Mr. Samuel said he wanted to make it quite clear that in taking the course which they were taking the Government were animated solely by the sense of the legal difficulties of the position and not by any feeling that they had any reason to be dissatisfied with the contract itself. The terms used in the resolution passed by the Committee, he said, " Having been informed by the Postmaster-General that the Government are not prepared to enforce the agreement," suggested that it was within the option of the Government to enforce the agreement and to make the Marconi Company carry out the contract if the Government desired to do so. He had endeavoured to make it quite clear to the Committee, he said, that it was because the Government felt themselves not to be in such a position in regard to their legal capacity to enforce the contract that they were taking the course they had. Mr. Samuel was assured by the Chairman and other members of the Committee that the reason for which the Government did not see their way legally to enforce the contract was entirely understood by every one of them.

In the House of Commons, on July 4th, Mr. Herbert Samuel made a statement explaining the course which the Government intended to take in order to secure the erection of the necessary stations for a system of wireless telegraphy in the Empire. The Government, he said, held the view they held a year ago, that they ought not to ask Parliament to take the risks of inviting open

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tenders for the erection of these stations, in view of the fact that they were advised that no firm that would enter into competition with the Marconi Company could be relied on to erect stations of a satisfactory character. The Advisory Committee over which Lord Parker presided declared :—

> The Marconi system is at present the only system of which it can be said with any certainty that it is capable of fulfilling the requirements of the Imperial chain.

The Government had considered again whether the erection of stations on that system should be by a staff of engineers using the powers of the Patents Acts or whether they should endeavour to arrange a fresh agreement with the Marconi Company. It was clear that the Post Office itself was not in a position to undertake the erection of those stations, for they had no staff which could by any possibility accomplish that task. The Board of Admiralty were again consulted on the matter, and he, Mr. Samuel, received from them on June 7th of this year the following letter :—

> Referring to Admiralty letter of January 30th last, which stated that my Lords Commissioners of the Admiralty were unwilling and, in fact, unable without prejudice to naval interests to undertake the work of erecting or working an Imperial wireless chain, I am commanded by their lordships to inform the Postmaster-General that they have carefully considered this matter and must definitely adhere to the opinion already expressed.

The only remaining alternative to contract with the Marconi Company was the creation of a new staff and the employment of an engineer of some distinction and capacity who would supervise the erection of the stations. That course, however, was attended by many serious disadvantages. He was advised that there was no one in this country outside the Admiralty and the Marconi Company who had any actual experience either of the erection or the working of long-range wireless stations—not even the members of the Advisory Committee themselves. If any engineer without that experience were chosen he would have to collect together a staff as best he could ; he would have to prepare fresh designs and he and his staff would have to gain experience in this most difficult undertaking as they went along. The history of wireless telegraphy was strewn with so many failures and disappointments that the Government would have taken indeed a grave risk if they proceeded on the lines he had described. Further, it was likely that the estimated cost would be exceeded. It must not be thought that by the use of the Patents Acts the Government would be free from royalties to the Marconi Company. If the power of the Crown to use the Patents Acts without the agreement of the patentee was exercised the patentee had to receive royalty payment fixed by the Treasury. The Patents Acts extended only to this country, and that would involve obtaining an adjudication upon the royalty payments of each country upon each piece of Marconi apparatus, and a separate adjudication under the various laws of all the six countries in which the stations of the wireless chain would be situated. To adopt this course would necessarily involve very considerable delay compared with the erection of the stations by the Marconi Company, who had their designs ready, their engineers available, and would set to work immediately.

The Select Committee were unanimous with regard to the question of urgency, and in view of the importance of the strategical interests involved, the Government were loth to incur the risk of this long delay which would probably be involved by the selection of an engineer who had first not had experience of what was required and the enlistment of a special staff. At the request of the Government, he, Mr. Samuel, undertook to ascertain on what terms a new contract could be entered into with the Marconi Company. The Company asked as a condition of entering into a new contract, first, that an allowance should be made for the increase which had taken place in the price of materials since July, 1912, when the previous contract was entered into, and they made the proposal that whatever should be ascertained by agreement, or failing agreement, arbitration, to be the actual increase in the cost of the materials needed for the stations during the interval between the signing of the old contract and the ratification of the new should be added to the purchase price of the stations. They ascertained that the additional cost which would be incurred in consequence of lapse of time would be

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about £6,500 per station. Mr. Samuel said that he could not but feel that the request with regard to the variation of prices according to the ascertained variation in the cost of materials was a reasonable request and could not be denied. In order to meet the not unreasonable request with regard to payment, he was willing to pay the company interest at the rate of 2 per cent. The company also requested that the contract should not be binding on them for a longer period than August 31st this year; in view of the circumstances, he thought the House would consider this a reasonable proposal.

Time did not permit the Postmaster-General to complete his statement to the House, and in the course of the evening he issued further details, particularly with regard to the following clauses in the contract:—

1. That the royalty should be payable for each station separately, and that if Marconi patents were used in some and not in others, it was to be clear that the royalty should be payable not in respect of the receipts of the Imperial chain, but only in respect of the receipts of the stations where the patents were used.

2. That while the contracts should be for six stations as originally arranged, in England, Egypt, East Africa, South Africa, India, and the Malay Peninsula, the Government should at any time before the completion of the stations in South Africa, India, and the Malay Peninsula, or of any of these three, have the option of calling upon the Marconi Company to cease work upon them should it be desired to install other apparatus. It was provided, however (*a*) that the company should be recouped for any actual expenditure they had incurred, and (*b*) that if the Postmaster-General desired to install some other system of wireless telegraphy, he should not give preference to any other contractor if the Marconi Company could show to his satisfaction that they were able to provide that alternative system with equal efficiency and economy.

3. It will be made clear that the stations during the course of their erection and during the trial period provided for in the contract should be available for Government experiments, provided that their normal working would not be impaired.

4. The company had previously guaranteed the speed of transmission of 50 words a minute by automatic apparatus, except during periods of exceptional electrical disturbance of the atmosphere, and a speed of 20 words a minute by hand signalling apparatus at all times. They are now in a position to guarantee a speed by automatic working of 75 words a minute.

5. It has been urged in discussion on the contract that such parts of the stations as engines and dynamos, which are not peculiar to the Marconi system, ought to have been obtained by competitive tender, and that had this been done the price of the stations would have been less. It is the case, however, that the Marconi Company had invited competitive tenders for such portions of the plant, and the price which they quoted for the stations was based upon the result of that competition. They have now agreed that the list of sub-contractors who had tendered should be submitted to the Postmaster-General, and that the selected sub-contractors should be approved by him.

6. Clause 11 of the original contract provided that if the Government desired to install in any of the stations erected by the Marconi Company apparatus in addition to or in substitution for theirs they should "seek but should not be bound to act upon the advice of the company." It has been suggested that this might enable them to obtain information of inventions by their competitors which those competitors would desire to keep secret. One Postmaster-General, on the other hand, has stated that it was never intended, nor did the terms of the contract require, that any such secrets should be communicated to the company, and that what was proposed was that the nature of these inventions which it was proposed to substitute should be communicated to the company in general terms. It is now agreed, however, that the provision in clause 11 should be omitted.

7. In clause 18 of the original contract it was provided that with regard to any new stations to be erected by or for the Government, not by the Marconi Company, where the company "had reason to suspect infringement of their patents," they should have the right of inspection to ascertain whether or not such infringements had, in fact, taken place. This provision has been subjected to criticism on similar grounds.

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The company, in view of their experience of the many infringements of their patents that have taken place in various countries of the world, and in view of the costly litigation in which they have been frequently engaged, were unwilling to agree to the omission of this clause. It has been arranged that the provision in the new contract shall run : " If they satisfy the Postmaster-General that they have reason to suspect " that their patents are being infringed they shall have the right to nominate, with the concurrence of the Postmaster-General, an independent engineer of high standing to make the inspection.

There are also a small number of minor and drafting amendments embodied in the contract.

QUESTIONS IN PARLIAMENT.

The Postmaster-General has had to answer a large batch of questions almost daily in the House of Commons regarding the Imperial Wireless Chain. On July 9th he informed several members that he had no official information as to the results of experiments which were said to have been made with the Goldschmidt system, but he was making immediate inquiries.

On the 10th he informed the House that he had received a letter from the British representatives of the Goldschmidt system, conveying information which had appeared in the newspapers of the preceding week, and inquiring respecting the contract for the Imperial Wireless Chain. He at once asked them to arrange for representatives of the Post Office and the Admiralty to attend a demonstration of the working of their system, but he had not (July 10th) received a definite reply from the company.

On July 11th Mr. Samuel stated that the decision not to invite tenders was adhered to by the Government after the repudiation of the contract of July, 1912, partly as a consequence of the report of the Technical Advisory Committee presided over by Lord Parker. That report stated that according to the result of their investigations " the Marconi system was at present the only system of which it could be said with any certainty that it was capable of fulfilling the requirements of the Imperial chain." He was asked whether the objection to the contract being thrown open to public competition might be overcome by requiring the parties tendering to give a substantial financial guarantee for an efficient service. To this he replied in the negative. " We want," he said, " to be sure that the contractors will be able to perform the services required. A financial guarantee will not be adequate ; actual tests are essential beforehand."

On July 11th he was still waiting permission from the Goldschmidt Company to send Post Office and Admiralty officials to watch any demonstration that they might be in a position to make.

In answer to further questions on July 14th, he stated that representatives of the Goldschmidt system accepted the invitation of the Parker Committee to demonstrate the working of their system, but only over a distance of 382 miles between Hanover and Slough. Members of the Committee were in attendance at Hanover and engineers were sent to Slough to watch the tests, but the demonstrators did not succeed in transmitting any intelligible communication of any kind. On seeing the paragraphs recently sent to the Press by the company to the effect that they had established communication between Hanover and Tuckerton in the United States, he (Mr. Samuel) at once asked the company to allow the demonstrations to be witnessed by officers of the Post Office and the Admiralty, but the company had replied that they were not in a position to give any demonstrations until the first week in August. Under the circumstances he did not propose to invite tenders for the work. Mr. Samuel stated further that the Goldschmidt experiments took place between July 3rd and 4th, the company communicated to him on July 5th that these experiments had been made, and he wrote to them, he thought, on July 6th or 7th, asking that demonstrations should be made before his officers at the earliest possible date. A telegram was sent on the following day, and another letter was sent two or three days afterwards. About July 12th he received a letter from the company stating that they were not in a position to give any demonstration until August. So far as he was aware, the statement that by the Goldschmidt system messages had been sent " over a far greater distance, and under more difficult conditions " rested entirely on Dr. Goldschmidt's statement.

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With regard to the Poulsen system, Mr. Samuel said that the general results of the experiments in the United States were before the Scientific Advisory Committee when they made their report, and they were not such as to lead the committee to conclude that the Poulsen system was capable of fulfilling the requirements of the Imperial chain. The agreement between the Canadian Postmaster-General and the representative of the Poulsen system was entered into in April of this year, and was of a wholly different character from that proposed for the erection of stations for the Imperial wireless chain. The Canadian Government did not propose to employ the Poulsen Company to erect any stations to be owned and worked by the Government; the station was to be erected by the Poulsen Company at their own cost, it was to remain the property of the company, unless purchased by the Canadian Government, and it would be worked by the company at their own risk.

On July 15th Mr. Samuel was again asked whether the tender of the Goldschmidt Company would be accepted, subject to the results of demonstrations being satisfactory, but he replied in the negative. He replied that he had not sufficient confidence that the tests would be satisfactory to begin with to make it reasonable to adopt the suggestion made by an honourable member.

Mr. W. Guinness obtained leave on July 16th to discuss the new Imperial Chain on a motion for the adjournment of the House. Mr. Guinness's object was to call attention to the refusal of the Postmaster-General to allow any other company than the Marconi Company to tender for the erection of the stations. Several members took part in the discussion of the motion, including Mr. J. J. Mooney, who served on the Select Committee and who informed the House that in the mass of correspondence put before that Committee he came across a letter in which the Poulsen Company promised to do in a few months what in seven years they had not done, for the date of the letter was 1907.

Mr. Herbert Samuel, in referring to rival wireless telegraph systems, emphasised the fact that there was all the difference in the world between promise and proved capacity. In 1907, he said, the Poulsen Company then at work sent a representative to the Post Office, who said that the company had absolutely no doubt of being able to establish a thoroughly satisfactory service in America; their wireless experiments in Germany, he added, had been most successful, and they hoped soon to introduce their system into England. That, said Mr. Samuel, was in 1907, and from that day to this the Poulsen Company had established no trans-Atlantic service. Some months ago he was pressed to adopt the Poulsen system on the ground that they had established a day and night communication between San Francisco and Honolulu. On July 11th the Foreign Office telegraphed to the British Consul at San Francisco asking whether the Poulsen Company had a wireless service by day in operation; he replied on July 12th, "No. Non-completion at Honolulu is causing delay." Mr. Samuel laid stress on the fact that the expert committee who reviewed the existing systems had reported that "the Marconi system was the only one of which it could be said with any certainty that it could be capable of fulfilling the requirements of an Imperial Chain." He also communicated to the House the four opinions that he had received that day; they came from the Engineer-in-Chief of the Post Office, the Inspector of Wireless Telegraphy (who had been at the Admiralty and was now at the Post Office), the President of the Institution of Electrical Engineers, and Lord Parker. All were to the effect that it would not be advisable to invite tenders from the Poulsen Company and the Goldschmidt Company at the present moment. Mr. Samuel observed that nothing would induce him to change a course which he knew to be in the public interest.

The motion was talked out by Mr. Austen Chamberlain.

In the House of Commons on July 21st, on the motion of Mr. Masterman (Financial Secretary to the Treasury) a return was ordered containing "copy of agreement between Marconi's Wireless Telegraph Co., Ltd., Commendatore Guglielmo Marconi, and the Postmaster-General, with regard to the establishment of a chain of Imperial wireless stations, together with a copy of the Treasury minute thereon."

On July 23rd the Prime Minister informed the House of Commons that it was proposed to give Friday, August 1st, provisionally, as a day for the discussion of the contract.

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LEGAL REPORTS.

Wireless in Australia.

THE Judicial Committee of the Privy Council dismissed the Australian Government's petition for leave to appeal against the decision of the High Court of Australia making an order for the inspection by the Marconi Company of the wireless telegraph plant installed in the Commonwealth stations. The petition was heard in London on July 4 by the Lord Chancellor, Lord Dunedin, and Lord Atkinson, and at the close of the arguments for the Commonwealth their Lordships refused leave to appeal, without calling on counsel for the Marconi Company.

The following summary of the proceedings appeared in the *Times* :—

"On February 13th, 1912, the Marconi Company brought an action in the High Court against the Commonwealth of Australia, under the Patent Acts, 1903–9, and the Judiciary Acts, 1903, for the alleged infringement of the Marconi letters patent in the six States of the Commonwealth. The system of wireless telegraphy used by the Commonwealth is the invention of Mr. Balsillie, the engineer for radio-telegraphy for the Commonwealth Government, and was assigned to the Government by him. Mr. Balsillie asserted that it was an entirely different system from that attacked in the case of Marconi and others *v.* The British Radio-Telegraph and Telephone Company. On March 21st the Marconi Company took out a summons for an order to inspect and examine the plant erected by the Commonwealth. The High Court made no order at that time, but declared that the company were not to be prejudiced in any application they might afterwards make for inspection of the plant and works of the Commonwealth. During the hearing it was stated that the wireless telegraphy used by the Commonwealth would form the subject of an application for letters patent, supported by a complete specification which would probably afford the respondents all the information required without an actual inspection. On September 23rd, 1912, applications accordingly were lodged in the Patents Office in Melbourne for two inventions by Mr. Balsillie, accompanied by complete specifications. The respondents obtained inspection of these specifications.

"On December 11th the respondents took out a summons for an order for inspection of the plant. The Commonwealth opposed the summons in an affidavit filed by the Postmaster-General's Department. The ground of the opposition was that, in the opinion of the Postmaster-General, it would be prejudicial to the public interest to allow any inspection of the wireless telegraphy stations of the Commonwealth.

"On March 20th last the High Court (Mr. Justice Isaacs dissenting) made an order for inspection. The view of the majority of the Court was that the opinion of a responsible Minister of the Crown was not conclusive, but could be examined by the Court, and that there was nothing to warrant even a conjecture that the inspection would disclose anything which could reasonably be called a State secret. The view of Mr. Justice Isaacs was that the Court was bound to accept and act upon the opinion of the responsible Minister unless it was clearly shown that the inspection could not be prejudicial to the public interest, and that it had been established that the evidence and inferences pointed in a contrary direction. From this decision the Commonwealth Government now sought special leave to appeal, urging that the matter of law involved was of great public importance."

Patents Action.

THE following particulars of the action brought by the Marconi Wireless Telegraph Co. of America against the National Electric Signalling Co. (Fessenden) appeared in the *Electrical World* of New York.

There are two distinct suits comprising the present litigation, the first referring to Marconi's United States patent re-issue No. 11,913 (original No. 586,193, filed December 7th, 1896, and issued July 13th, 1897) and to No. 609,154 (filed February 1st, 1898, and issued August 16th, 1898) of Sir Oliver Lodge, while the second suit is based upon United States patent No. 763,772, issued to G. Marconi, June 28th, 1904, on application dated November 10th, 1900. *Prima facie* evidence in both cases was begun

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in August, 1912, by Mr. W. R. O. Wiegant, who stated that he had been employed by the defendant National Company, and who described in detail the arrangement of apparatus which constituted the alleged infringement. In October and November of the same year Mr. Frank L. Waterman, of New York, closed the complainant's proofs with his expert testimony. The first evidence in defence was taken last February, and was not completed until April last. The rebuttal case of the first suit was opened before Judge Veeder on June 16th with evidence of Mr. G. Marconi, which continued for three days. This was followed by other evidence.

The only claim of No. 11,913 in issue is as follows :—

" 3. The combination, in an apparatus for communicating electrical signals, of a spark producer at the transmitting station, an earth connection to one end of the spark producer, an insulated conductor connected to the other end, an imperfect electrical contact at the receiving station, an earth connection to one end of the contact, an insulated conductor connected to the other end and a circuit through the contact, substantially as and for the purpose described."

Mr. Marconi and Mr. Waterman gave rebuttal evidence on this claim, maintaining that it should be held to cover any system of radiotelegraphy utilising earthed waves. The " imperfect contact " element is considered the keystone of the combination, since the complainant claims it to include all oscillation detectors, even those of the " good contact " crystal or electrolytic types. The National Company urges that the patent should be read in the light of wireless knowledge at the time of its application date, and that Mr. Marconi's claims should be limited to the original intentions of the inventor, as shown by his early lectures and publications. The complainant goes so far as to classify the hysteresis-type magnetic detector as within claim 3 above, stating that while it may not be an " imperfect contact " device, it acts like one, and is therefore an equivalent. The defendant company is attempting to show that the crystal and electrolytic detectors are outside the claim quoted, since, if read in the light of the specification, the " imperfect contact " is a resistance-varying device which controls power from a local battery, and makes signals thereby. It is claimed by the National Company that when the crystal or electrolytic detectors are used all response given is produced by power received on the antenna, the local battery being used only to increase the sensibility of the detector, and the work of Dr. G. W. Pierce, as well as of the company's experts, is pointed out in confirmation of this view. Mr. Marconi also states that in addition to his invention of the combination, including an imperfect contact, he is also entitled to a monopoly covering the use of earthed waves for wireless telegraphy.

The Marconi re-issue patent was sustained as to claims 3 and 5 against the De Forest Wireless Telegraphy Co. in 1905 by Judge Townsend. In that instance infringement was determined mainly by defendant's use of the De Forest-Smythe " goo " detector, which was held to be a true anti-coherer resistance-changing device. The bearing of the earlier decision upon the present case does not seem very direct, except in that Judge Townsend appeared to feel that he was extending a liberal range of equivalents to Marconi by placing the " goo " detector within the coherer class.

The Lodge patent, No. 609,154, has in issue claims 1, 2 and 5, of which the first is representative :—

" 1. In a system of Hertzian wave telegraphy, the combination with a pair of capacity areas of a self-inductance coil inserted between them electrically for the purpose of prolonging any electrical oscillations excited in the system, and constituting such a system a radiator of a definite frequency or pitch."

The second suit, No. 31, upon Marconi's patent No. 763,772, in which the rebuttal testimony is not completed, alleges infringement of 15 claims of the patent, including the following :—

" 8. At a transmitting station employed in a wireless telegraph system the combination of a transformer whose secondary is connected to an open circuit, including a radiating conductor at one end and capacity at the other end, a variable inductance being included in said circuit, and whose primary is connected to a condenser circuit discharging through a means which automatically

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causes oscillations of the desired frequency, substantially as described.

" 10. A system of wireless telegraphy, in which the transmitting station and the receiving station each contain an oscillation transformer, one circuit of which is an open circuit and the other a closed circuit, the two circuits at each station being in electrical resonance with each other and in electrical resonance with the circuits at the other station, substantially as described.

" 19. In a system of wireless telegraphy the combination at a receiving station of an oscillation transformer; an open circuit comprising, in part, an aerial conductor connected with one end of the primary coil of the oscillation transformer; a connection from the other end of said coil to capacity; a variable inductance in said open circuit, and electrical connections from the secondary coil of the oscillation transformer to a receiving instrument, battery, condenser, wave-responsive device and a variable inductance, substantially as and for the purpose described."

This is the United States patent of Marconi on " four-circuit tuning," and it corresponds to the British 7,777 patent of 1900, which was sustained by Mr. Justice Parker against the British Radiotelegraph & Telephone Co. in 1911. The defence of the National Company is said to be based upon anticipations of the patent in the work and publications of Tesla, Fessenden and others.

Interrogatory Allowed.

In the Chancery Division on July 9th Mr. Justice Eve had before him a summons in an action brought by G. Marconi and Marconi's Wireless Telegraph Company, Ltd., against the Helsby Wireless Telegraph Company, Ltd. The action was to restrain infringement of the well-known wireless patents granted to the inventor in 1900. Leave was asked for by plaintiffs to administer certain interrogatories as to the state of the defendant company's plant since an inspection was made of it by the plaintiffs. In giving judgment, his Lordship said that but for the fact that the Court of Appeal in a recent case had refused to allow an interrogatory which he had allowed, he would have entertained no doubt that the plaintiffs were entitled to put the interrogatory in question. The plaintiffs alleged infringement by reason of an installation in Milton Road, Liverpool, and an inspection of that plant was made by the plaintiffs in May last. He gathered that the result of that was that the plaintiffs were of opinion that there had been alterations made in the construction of the installation between its erection and May, 1913. They wished to know in what manner the construction had been altered. It was suggested that such an interrogatory was a fishing one and an endeavour to establish, by means of an admission, that which the plaintiffs could not prove otherwise, and it ought not to be allowed. His Lordship thought, however, that in the present case the facts were capable, and that the admissions of the defendants would save a great deal of time, trouble, and expense. The interrogatory would be allowed and must be answered within fourteen days.

Apology to Mr. Marconi.

The libel action brought by Mr. Marconi against the Berlin weekly paper *Die Welt am Montag*, has been settled by agreement. The responsible editor has undertaken to print in his journal a statement admitting that it was not true that Mr. Marconi testified before the American Commission of Enquiry into the loss of the *Titanic* that his company had sought to make money out of that disaster—the libel of which Mr. Marconi complained—and expressing regret for publishing this statement. The statement is withdrawn, together with the inferences drawn from it by the journal.

The Share Market

London, July 24th.

Business on the Stock Exchange during the past month has been on the smallest possible scale. In the first place the strike on the Rand, which at one time assumed very serious proportions, caused considerable anxiety as to the position here should the flow of gold from South Africa be interfered with. Fortunately these difficulties have, for the time being at any rate, been surmounted.

The market for Industrials has been very quiet and there is little change in the prices of the various Marconi Issues.

Ordinary, 3⅞; Preference, 3; Canadas, 10/-; Spanish, ⅞; American, $\frac{13}{16}$.

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COMPANY MATTERS.

Marconi International Marine Communication Company (Limited).

CONTINUED DEVELOPMENT OF THE BUSINESS.

The 13th Ordinary General Meeting of the Marconi International Marine Communication Company (Limited) was held on June 23rd at the offices, Marconi House, Strand, Mr. Godfrey Charles Isaacs, the managing director, presiding.

The Assistant Secretary (Mr. H. W. Corby) having read the notice convening the meeting and the auditor's report,

The Chairman said: Gentlemen, Commendatore Marconi has been obliged to remain rather longer in the United States of America than he had contemplated, and I am taking the chair in his absence. I assume that we may follow the usual custom and take the directors' report and the accounts as read. The report and accounts are before you, and you have seen—I am sure, with some satisfaction—that the business of the company continues to develop. The figures are set out in the directors' report, and indicate during this last year a very substantial increase in the receipts and in the number of ships equipped; consequently the net profit shows a proportionate increase, amounting to between £9,000 and £10,000 over that of the preceding year. One of the items which is of particular interest, I think, is that of the ships' telegrams traffic and subsidies, etc., the revenue from which during the past year has exceeded £100,000. The number of ships equipped up to the end of last year was 580, and to date it has reached 686, and is still continuing to increase in much the same ratio.

We are conducting a business which has an immense organisation, and which serves a very valuable purpose to the mercantile marine. I do not know that there is another industrial business which plays a more important part in the world than does wireless telegraphy on ships at sea. During the past twelve months there were a very large number of instances where it is more than probable, in past times, when there was not wireless telegraphy, that many ships would have sailed from their ports and would never again have been heard of. In practically all cases where wireless telegraphy has been employed not only have all the passengers been saved, but the ships themselves. I do not know yet what part wireless telegraphy may play in reducing the cost of insurance to ship owners. It seems self-evident, however, that it will do so, for whereas in the past a number of ships would have been total losses, in very many instances—in fact, I think in every instance where a ship has been fitted with wireless telegraphy during the past year—both ships and cargo have been saved.

LEGISLATION RESPECTING WIRELESS TELEGRAPHY.

There has been a considerable amount of legislation during the past year in nearly all countries which have a mercantile marine providing that ships should be fitted with wireless telegraphy. There has been a certain limit to which this law applies. In most cases it touches only ships carrying 50 persons or more, whether they be passengers and crew or crew alone. I think myself that this is likely only to be a beginning of such legislation, and that as time goes on we shall find that the law will be made to apply to every ship that sails from a port. Personally, I cannot see why it should not be so, for whether there be 50 persons on a vessel, or 25 or less, it seems to me that if there be a means of safeguarding the lives of those who leave port, it should be applied in every instance. In this country we are expecting similar legislation. Exactly what line it will take I am not yet in a position to advise you, but I contemplate that it will go rather further than that which has so far been enacted in other countries. I do not think there is anything more I can usefully add. I shall be very pleased to answer any questions which shareholders may desire to put to me, and in the meantime I will propose, "That the report of the directors submitted, together with the annexed statement of the company's accounts at December 31st, 1912, duly audited, be received, approved, and adopted."

Mr. Henry Spearman Saunders—I second that. I am sure that the shareholders are all satisfied with the progress which the company has made during the past year.

The motion was carried unanimously, without discussion.

Captain Henry Riall Sankey, R.E., proposed:—"That Major Samuel Flood Page and Mr. Alfonso Marconi, the retiring directors, be re-elected directors of the company." He remarked that Major Flood Page and the company had grown up almost together, and they were all very sorry that that gentleman was not with them on that occasion. He had been seriously ill for some time, but they hoped that he would soon be among them again. As regarded Mr. Marconi, his name was quite sufficient to ensure his re-election.

The Chairman formally seconded the motion, and, having declared it carried unanimously, said:—I have now to move, "That the remuneration of the directors for the year 1913 shall be the sum of £1,000, subject to such further sum, if any, as may be determined at the next general meeting of the company."

Mr. Alfonso Marconi seconded the motion, which was carried unanimously.

The Chairman—It is now my pleasure to propose, "That a dividend at the rate of 10 per cent. for the year ending December 31st, 1912, on the 204,056 shares issued be paid on July 31st, 1913, to the members who are on the register as the present holders thereof."

Mr. Saunders seconded the resolution, which was carried unanimously.

Messrs. Cooper Bros. & Co. were re-elected auditors for the ensuing year.

Share Issue.

The following circular was issued on July 11th:

"During the past few years the business of the Marconi International Communication Co., Ltd., has undergone rapid expansion, as is clearly shown by the following figures, which have

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been extracted from the Annual Reports to the Shareholders:

Year.	Ship Telegraph Stations.	Traffic Revenue.	Dividend.
		£ s. d.	
1910	250	40,535 15 8	5%
1911	350	64,165 16 8	7%
1912	580	100,325 3 10	10%

"The number of ships equipped at this date is 686, the installations being the property of this Company.

"At the present time the Company have large orders in hand, and much further business lies ahead. Further capital outlay is consequently necessary, and in order to provide the additional funds required, the directors now offer to the shareholders 102,028 shares of £1 each (part of the total unissued balance of 145,944 shares) at the price of £1 5s. per share in the proportion, so far as practicable, of one new share to every two issued shares. The Spanish and General Wireless Trust, Ltd., have bound themselves in consideration of a commission of 1s. 6d. per share on the whole issue, and an option over the remaining 43,916 unissued shares of the Company at the price of £1 5s. per share, to take up at the same price any of the shares now offered which are not taken by the shareholders, or those in whose favour they renounce their rights.

"Marconi's Wireless Telegraph Co., Ltd., who by virtue of their holding in this Company are entitled to an allotment of 94,395 of the above shares, have made arrangements for passing on the benefit of their allotment to their own shareholders.

"A special settlement on the London Stock Exchange will be applied for in due course."

Applications had to reach the Company's Bankers by July 19th.

Compania Nacional de Telegrafia Sin Hilos

During the past year the Compañia Nacional de Telegrafia Sin Hilos quietly concentrated their efforts upon the development of wireless telegraphy in Spain. In their annual report the Directors refer to the successful completion of seven of the first group of eight long-distance stations in Spain and the Canary Islands. Further proposals have been submitted, and are now under the consideration of the Government, with the object of extending the original scheme.

Favourable opportunities exist for the extension of the wireless telegraph service in the North African territory under Spanish influence, and the company have entered into negotiations with the State Departments concerned with a view of establishing in North Africa stations that will be capable of conducting all classes of communication. Steady progress is being made with the erection of the stations comprised in the second group.

The Cadiz and Vigo stations are working satisfactorily, and traffic through these stations continues to increase daily. The Spanish Coast stations have suffered somewhat in competition from stations on the French Coast, but it is hoped that a satisfactory arrangement will be made shortly, and that the disadvantages under which the Spanish Coast stations have hitherto been worked will be removed. The Barcelona and Soller stations are also working excellently, and with the opening of stations at Santander, Finisterre, Malaga, Cabo de Palos, Huelva, etc., traffic receipts will increase very appreciably.

Wireless telegraphy has again demonstrated to the country its reliability as a means of communication from shore to shore. The latest demonstration was afforded by the breakdown of the Canaries cable. During that time communication between the Peninsular and the Canaries was carried on through the Marconi stations, and so reliable was the service that a petition has been granted with a view of making this wireless service a permanent one.

The State Department are at present negotiating with the English and Italian Post and Telegraph Departments with a view of establishing direct communication between the east coast of Spain and Italy and Aranjuez and Vigo and this country.

The report refers to the demonstrations carried out in Spain with the Marconi portable wireless telegraph station in 1912. Some of the demonstrations were witnessed by their Majesties the King and and Queen Dona Maria Christina, and high officials of the Government and the Army. Trials were conducted between Madrid, La Granja, Burgos, and San Sebastian, and the results were so satisfactory that the War Office, by Royal Order, arranged to purchase two stations.

In addition to this the company have also secured orders for equipping vessels of the Spanish Navy, among which may be mentioned the *Princess de Asturias*, which has been equipped with a wireless telegraph station. The official tests of this station gave excellent results. The company have also installed a 15-kw. station on the armoured cruiser *Espana*, and tenders have since been submitted for the remaining ships now in course of construction for the Ministry of Marine.

The company succeeded in obtaining all the orders for wireless telegraph apparatus placed by the Ministry of Marine during the past year.

Compagnie Française Maritime and Coloniale de Télégraphie Sans Fil

The annual report and accounts of the Compagnie Française Maritime et Coloniale de Télégraphie Sans Fil were presented at the annual meeting held in Paris recently. A dividend of 10 per cent. was paid on the ordinary shares, and 10,150 frs. was added to the reserve. The scope of the company has considerably increased, and in order to enable it to carry on its operations in a wider sphere it has become necessary to increase the capital, for which the necessary arrangements have been made.

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CONCERNING RECORDS

THE following is a copy of a letter signed by Mr. Godfrey C. Isaacs, managing director of Marconi's Wireless Telegraph Co., Ltd., which appeared in the *Electrician* on July 18th last :—

"In your issue of the 11th inst., page 557, you say that you understand that a record has been created by the Goldschmidt system; the station at Hanover, equipped with 150 kilowatt Goldschmidt Alternator, has been able to transmit to Atlantic City in the United States, a distance of about 4,000 miles. May I point out that this is not quite accurate? The distance between Hanover and the Tuckerton station, Atlantic City, is 3,385 nautical miles, and I think it will not be disputed that the station at Hanover only sent out the letters "PAX," which represent the call letters of the station, and that the Tuckerton station did not reply. You will appreciate, I am sure, that there is a great difference between a station receiving the call signals which it is awaiting and its being able to receive messages in code or otherwise.

"The fact, too, that a machine is able to send out for two or three hours on three consecutive days station call letters, after which it is moved to Berlin for repair (which I think you will find will also not be disputed), is very different from a machine being able to work continuously day and night, week after week, and month after month, in sending and receiving messages, which is what would be demanded of it in conducting a commercial service. May I also point out that, given that the call signals "PAX" were sent from Hanover to Atlantic City, and were received there by the Tuckerton station, this would not constitute a record, for some years ago Mr. Marconi received signals at Buenos Aires which were transmitted to him by our Clifden station, a distance of over 6,000 miles, which achievement was reported in the *Electrician* on October 7th, 1910, on page 1085, by the following paragraph :—

> It is announced that Mr. Marconi, who has recently landed in Argentina, has notified Marconi's Wireless Telegraph Company of London that he has successfully accomplished wireless communication between Clifden (Ireland and Buenos Aires, a distance of 6,000 miles.

The Editor's comment on the above letter is as follows :—

> "In the note to which reference is made we did not suggest that the performance was a record as against other systems. We merely meant that it was a record so far as the Goldschmidt system was concerned; but perhaps we ought to have been more explicit."

Berne Notes

THE CONVENTION.—The International Convention, which was signed in London on July 5th, 1912, came into operation on July 1st last.

The convention provides for the organisation and control of the wireless services on ships. Two of its most important requirements are that there shall be a constant wireless watch on all ocean-going passenger steamers, and a free interchange of communication between ships and coast stations. (The Convention is published in full, together with the service regulations, in the YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1913.)

Among the countries which have already ratified the Convention are Denmark, Egypt, United States of America (with a slight reservation), Holland, Russia, Belgium, and Belgian Congo.

APPOINTMENTS, ETC.—The Berne Bureau has been informed that Mr. Alfred Massé has been appointed by the President of the French Republic Minister of Commerce, Industry of Posts and Telegraphs.

Mr. G. A. A. Alting von Gensau has been appointed Director-general of Posts and Telegraphs for Holland in succession to Mr. G. J. C. A. Pop.

Mr. J. J. Stieltjes has decided to retire from the office of Chief of the Department of the Posts, Telegraphs and Telephones of the Dutch East Indies: he will lay down his duties on August 3rd.

STATIONS.—The Minister of Marine at Athens has reported to Berne (Circular 48) the opening at Salonica of a Greek coast station for official service.

A public service station has been opened at Lisbon. The range of the station is 350 kilometres, wave-length 600 m., call letters C.R.F., coast tax 40 centimes per word.

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A "Hero" of the Siege of Adrianople

THIS month we are able to give our readers a photograph of the splendid cart set which did such historic work during the siege of Adrianople.

Before the outbreak of the Balkan War, this station had been sent by the Turkish Government, for experimental work, to the plains outside the city; but when the advancing Servian and Bulgarian hosts instituted a state of siege, it was taken within the city walls. It became the only means of communicating with the outside world; not once did it fail during the whole of the 153 days that the siege lasted. Constant messages were sent to Ok Meidan, the chief station of the Turkish Government, which is situated in the environs of Constantinople. The beleaguering armies endeavoured their utmost to tamper with the communication, and with this end in view set up cross stations, which were to intercept the waves and to nullify the messages by "jamming." Their efforts, however, were unsuccessful; in not a single attempt did they succeed in their purpose, and it is reckoned that some half-a-million of words safely reached the Turkish metropolis from Adrianople. This is a splendid feat, for the distance between the two cities is over 130 miles, and as the station is only a 1½-kw. cart type (which, it should be remembered, is not supposed to do the work of, or be as powerful as, a properly installed land station, however serviceable it may be for campaign work), it demonstrates the fact fairly conclusively—nor is this the only instance, rather it is common knowledge among all who have had to work with Marconi apparatus—that the Marconi stations can always do more than they are actually guaranteed to do, while the accuracy of the parts and the excellence of workmanship enable them to stand a strain which less well-made apparatus would be unable to bear.

Turkish Soldiers with their Marconi Portable Wireless Station in Adrianople before the Siege.

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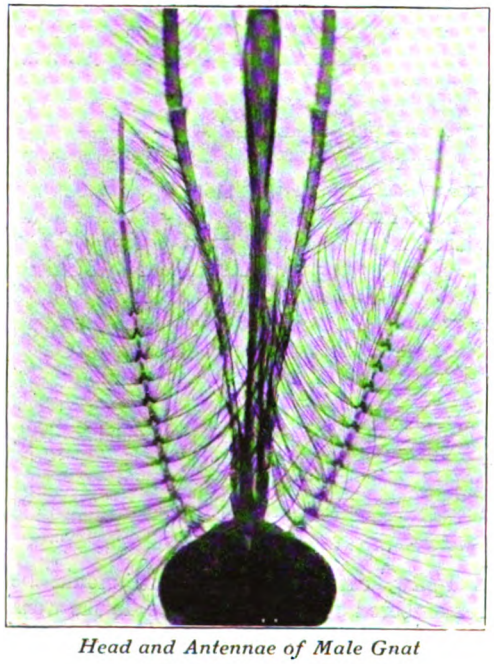
Wireless Telegraphy in Nature

By H. W. VENTON

WIRELESS telegraphy is as old as the hills. Long before man inhabited this earth the secret of distant communication without the medium of wires was already known to some of the inhabitants of this planet. And this communication did not depend upon the power of vision; for, in the vast majority of cases, it was possible where the two or more



Head and Antennae of Male Gnat

communicants were far removed from each other and where it was quite impossible for them to see each other. In the insect world wireless telegraphy appears to have been in use as long as insects have been in existence; indeed, science has recognised that Mr. Marconi has been anticipated by these tiny creatures by the fact that it has named one of the principal parts of a wireless installation after one of the organs of the insect. The "antennæ" of a wireless telegraphic apparatus, of course, derived its name from the antennæ of insects.

It is very remarkable, too, that both the mechanical and the natural antennæ seem to possess the same functions. The function of the man-made antennæ is to "pick up" the electrical waves; and the function of the antennæ of insects is also to pick up waves, though whether these be electrical or not in character has not, as yet, been absolutely determined.

Those who are unacquainted with the habits of insects would doubtless be surprised at some of the incidents connected with the communications between distant individuals which have been absolutely established. As an illustration of the manner in which certain butterflies and moths can make their presence known the one to the other, I will mention a little experiment which I tried some time ago, and which anyone sufficiently interested may repeat for himself. I had a good specimen of a live female emperor moth, and having heard of their alleged power of attracting males of their species, I put her into an ordinary two-pound jam jar and tied a piece of net over the top. I then went to the edge of a wood not far distant and set the jar upon the grass. I had not long to wait. In less than three minutes I saw something fluttering above the jar, and in another moment a beautiful specimen of a male emperor moth was scrambling over the net in an endeavour to get within. In about a minute longer another male had arrived, and in less than a quarter of an hour there were five blindly endeavouring to force their way inside.

It is practically certain that the power by which this communication is effected resides in the antennæ. In nearly every instance it is the male insect which is attracted from incredible distances to seek the female. And when the antennæ of the two sexes are examined we find a remarkable difference

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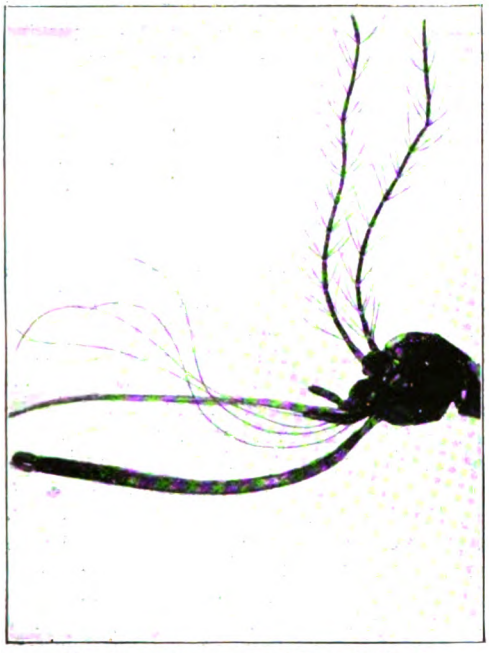
between them. The antennæ of the male is nearly always more elaborate than that of its mate. It has generally a great many more branches and these branches are very much more finely divided than those of the female insect, besides which they are covered with innumerable tiny hairs, in most cases more delicate than the finest cobweb. From these facts one would judge that the antennæ of the male insect is a most delicate receiving instrument, by means of which the faintest waves emitted by its mate are picked up.



Head and Antennae of Female Gnat

Whether or not these waves are emitted by the female antennæ it is difficult to determine; the whole question of distant insect communication is, as yet, unsolved.

Accompanying this article are two illustrations showing the head and antennæ of the male and female gnat. The difference between them is exceedingly striking, and the fact that these insects seem to possess the power of distant communication to a remarkable degree, combined with the extreme difference in the antennæ, seems distinctly to point to the fact that they are the external organs of a wireless telegraph plant similar in many respects to that used by mankind.

During recent years remarkable discoveries have been made with regard to the capacity of animals, including, of course, insects, to generate electricity; and it will not do for us to dismiss from our minds as utterly incredible the possibility that the waves received by the antennæ of insects are electrical ones. As an instance of the electrical susceptibility of insects it may be mentioned that glow-worms are exceedingly responsive to atmospheric electrical disturbances. Some time ago a gentleman who kept a large number of these little insects in his study noticed that on the approach of a thunderstorm their light became brilliant, and that it could be seen, even in weak daylight, which is very unusual. There is a centipede which is named *electricus* on account of the fact that it is able to emit electrical discharges; and among the higher, or rather larger, animals there are some which have complete storage batteries inside them. There are many fishes which are able to render themselves almost immune from attack on account of the fact that they can give severe shocks to an enemy seeking to destroy them; and not only is it possible to measure the voltage of the discharge, but it is also equally possible to light small electric incandescent lamps for a minute or two at a time, by connecting wires to the negative and positive portions of their bodies.

It is, of course, quite possible that insect "telepathic" communication may be non-electrical in character, and may be due to no special sense, but to one of the five senses known to us developed to a hypersensitive degree. Indeed, in many insects these organs appear to be organs of hearing; for the antennæ vibrate to a tuning fork of a particular note. But this does not invalidate the assumption that the antennæ of insects are comparable with those of a wireless plant, for, whatever these organs are for, they are to "pick up" waves of some kind; and during recent years science has come to regard all kinds of force and motion, whether it be electricity, sound, light or heat, as the result of vibrations, the only difference between them being in the length of the waves of which they are the manifestation.

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Australasian News

NEW USE FOR WIRELESS.—An unusual use was made of the wireless installation of the steamers *Maheno* and *Wimmera* during recent heavy weather in the Tasman Sea. The *Maheno* was proceeding to Auckland, and the *Wimmera* was going in the opposite direction. A message was sent from the *Wimmera* asking the *Maheno* if there was a doctor on board, and as Dr. Scott, a passenger from Tasmania, was travelling on the *Maheno*, a reply was sent accordingly. Then the instruments began to work, and there came to the *Maheno* news that Captain Entwistle was not well, and some particulars of his symptoms. Dr. Scott supplied the *Maheno's* operator with a prescription which was despatched to the invisible *Wimmera*.

* * *

HOURS OF WORKING.—According to the *Sydney Sun*, the purser of the American mailboat *Ventura* complained recently about the closing of the Sydney Station on Sundays. "We got into communication with Sydney and Brisbane on Thursday last," said Mr. Baker, "and spoke to both stations daily. But, when we were approaching Sydney on Sunday, we sent a wireless inquiring about atmospheric conditions, and, to our surprise, Sydney station replied to the effect that the station was officially closed on Sundays, and that no messages would be sent to the *Ventura* or any other vessel. "This is a most serious state of affairs," continued Mr. Baker, "for accidents will happen on a Sunday as well as any other day. It is to be hoped that if ever a ship is in trouble off the coast, and within range of the Sydney stations, that the operators will not be so officious."

* * *

GOOD WORK ON THE "ZEALANDIA."—Some fine performances have been achieved by the wireless station on the R.M.S. *Zealandia* recently. On the voyage to Vancouver from Auckland messages were sent to Sydney, 1,104 miles; Wellington, 1,000 to 1,200 miles; R.M.S. *Marama*, 1,100 miles; Suva, 1,189 to 1,785 miles; Awanui, 300 miles (received messages at 1,800 miles); Sonoma, 1,575 miles; Triangle Island, Vancouver, 1,200 miles. On the outward voyage from Vancouver some of the longest distances covered were:—Triangle Island, Vancouver, 2,250 miles; Estevan Point, Vancouver, 1,853 miles; Honolulu, 1,200 miles; Suva, 850 to 1,000 miles; Wellington, 1,100 miles; and Sydney, 1,320 miles. A message was also received from Triangle Island, Vancouver, when the steamer was 3,090 miles away. This is a record for a low-power station. During the whole voyage the *Zealandia* was kept informed of all the latest news by wireless, and not a day passed without the vessel being within range of some station or vessel.

* * *

DUTCH EAST INDIES STATIONS.—Rapid progress is being made in the Dutch East Indies with the erection of wireless stations, and these will prove most useful, especially as many steamers trading there are now fitted with wireless. The most powerful station in the Dutch East Indies is at Sabang, an island and coaling station north of Sumatra, with a minimum range of 1,000 miles, which brings it within reach of Colombo on one side and Batavia on the other. Other wireless stations have been installed, and are now working at Batavia, Sitoebondo (East Java), Koepang (the capital of Dutch Timor), and Amboina (Moluccas), while a sixth one is to be erected at Menado (Celebes). Menado is connected by cable with Macassar and Java, and as the stations at Amboina, Koepang, and Sitoebondo are inter-connecting, they will bring the eastern parts of the archipelago in regular wireless communication with other parts of the world. Apart from the above Government stations, the Royal Dutch Oil Company has wireless stations at Balik, Papan, and Samarinda (Borneo). The Royal Packet Company's new steamers, *Tasman* and *Houtman*, will both be fitted with wireless, and this is likewise the case with several of the company's steamers trading in the eastern part of the Indies, so that travellers to Java will practically remain in continuous wireless contact with the rest of the world.

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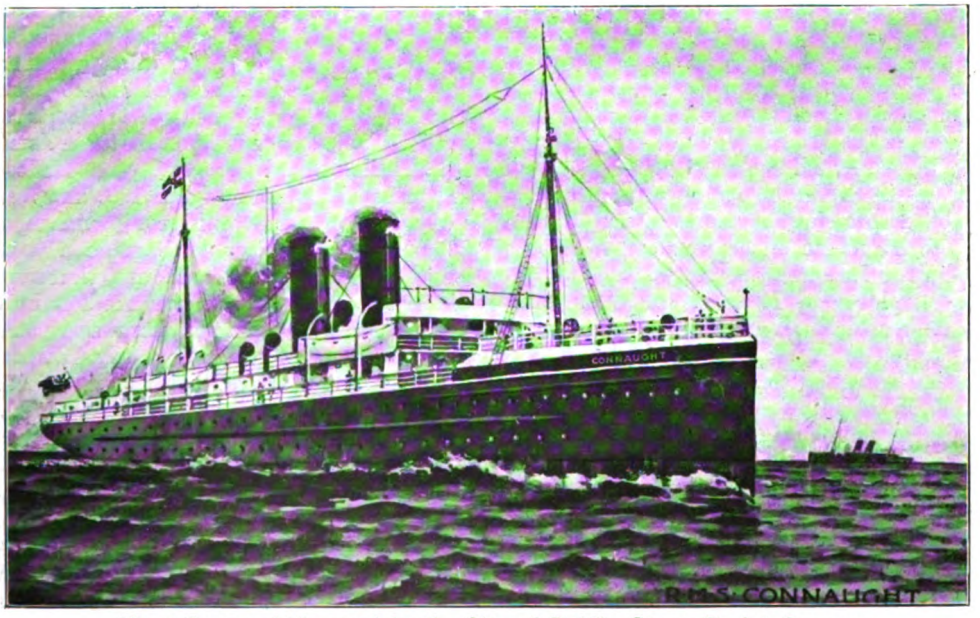
Maritime Wireless Telegraphy

The oldest steamship company in Great Britain and Ireland is the City of Dublin Steam Packet Company, which was established in 1823. Four of its twin-screw mail steamers, the *Ulster*, *Leinster*, *Munster*, and *Connaught*, are employed under contract with His Majesty's Government in carrying the mails between England and Ireland. They are fine vessels, each with a length of something like 370 feet, and a gross tonnage of over 2,600 tons. The engines are twin-screw, and the boilers are capable of developing 9,000 h.p., which gives the vessels a speed of 24 knots. The vessels are flush-decked, and have, besides the usual accommodation for passengers, a splendid reading saloon, a ladies' drawing-room, and a smoking-room. The first-class accommodation is all amidships, but the cabins for the second-class passengers are equally well placed and roomy. Each of the vessels is lighted throughout by electricity, and the fittings are on as lavish a scale as those of the modern liner. Everything that can be thought of has been installed for the convenience of the passengers, and, as an instance of what such convenience includes, mention may be made of the post-office which is installed in each of the ships, with a staff of forty sorters, who have large and commodious offices set apart for their special use. Each of the ships is fitted with the latest type of Marconi installation. This, by the way, calls for a special remark, as by a regrettable oversight the vessels had been omitted from the list of ship stations appearing in the *Year Book of Wireless Telegraphy and Telephony*. Readers who are anxious that their list shall be as complete as possible will do well to make a note of this fact in their volume.

* * *

A dispatch from New York dated July 2nd states that practically all the ships then in port have been equipped with wireless telegraph apparatus in compliance with the Act recently passed by Congress, and which came into effect on July 1st. The new law requires that all freight steamships, foreign and home, touching at American ports, and carrying more than fifty persons in their



The "Connaught," owned by the City of Dublin Steam Packet Company.

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crew, shall be equipped with wireless apparatus. The law also makes it necessary to have two operators on board, so that the wireless apparatus will never be without the service of an operator.

* * *

The Northern Navigation Company of Midland, Ont. (Canada), of which Mr. James Playfair is the President, is one of the most important lines plying on the Great Lakes, being particularly known for its excellent passenger service. On June 2nd the new 6,000 ton flagship of the company's fleet was launched at Port Arthur, and named the *Noronic*. Every modern improvement will be embodied in her design, including a wireless telegraph installation Her dimensions are : length over all 385 ft., moulded breadth 52 feet, and moulded depth 28 ft. 9 in., and there are six decks. The *Noronic* will sail between Sarnia, Sault Ste. Marie, Port Arthur, and Duluth, connecting at Port Arthur and Fort William with the Grand Trunk Railway.

* * *

As an instance of the striking advance in the conditions of British-Australian shipping, it is worthy of mention that the connection of the White Star Line with the Australian trade has been a long and honourable one. Commencing with sailing vessels somewhere back in the sixties, it has, within recent years, been developed by vessels of the largest type in the trade. Within the last twelve years the development has been phenomenal through the introduction of such magnificent vessels as the *Afric*, *Medic*, and *Persic* (12,000 tons), *Runic*, and *Suevic* (12,500 tons), and on July 24th the biggest steamer ever dispatched south of the line was sent by the White Star Line on her maiden voyage to Sydney. This was the *Ceramic*, an 18,500-ton, triple-screw, Harland and Wolff-built steamer, which left Belfast on July 8th for her trial trip. The *Ceramic* is armed, and is the first liner on which firing practice has been actually carried out. The guns are two in number—4.7 quick-firers. They throw a 45-lb. shell a distance of six miles. It is the intention of the White Star Line to mount guns in all their vessels employed in the regular Australian trade. The new liner is of the following dimensions : Length overall, 674 ft. 9 in. ; breadth extreme, 69 ft. 5 in. ; depth to upper deck, 48 ft. ; indicated horse power, 9,000 ; gross tonnage, 18,481. The *Ceramic* has been built on the latest and most approved principles, with a double bottom extending right fore and aft, and with twelve transverse water-tight bulkheads carried to the upper deck. To describe her spacious accommodation, her

A corner of the Wireless Telegraphy room on the "Ceramic."

artistic decorations or her life-saving appliances would soon exhaust the space at our disposal ; therefore we will content ourselves with the statement that she is equipped with a 1½ kw. Marconi station.

* * *

The application of wireless telegraphy to the Mercantile Marine has scarcely ever impressed itself with such force as it did in the Mersey on July 11th, when the King and Queen opened the new Gladstone Dock. The spectacle on which their Majesties looked when they embarked on the *Galatea*, the Dock Board tender, was indeed unparalleled. There were 109 ships in review, which were of a gross tonnage of 225,000, and the two lines made a total length of 10 miles. There was the giant *Mauretania*, ready to sail on the following day ; there were other great liners on either side of her, including the s.s. *Ceramic*, which had only arrived in the Mersey that week for her maiden voyage to Australia. The *Empress of Ireland* had her passengers on board, and left for Montreal half an hour after the close of the review. Arriving alongside the *Mauretania*, the King and Queen went on board and inspected the vessel. Their Majesties visited every quarter of the ship ; they spent nearly an hour on board, and took tea there.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire. His most recent invention is an airship worked by wireless, which is likely to revolutionise aerial warfare. Negotiations are proceeding with the War Office for its purchase from the inventor.*

GWEN THRALE.—*Charles Summers' fiancée, a bright, intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society. She coaxes Summers to teach her "wireless," and soon becomes a proficient operator and a bit of an engineer.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip. They are discovered and "tapped" by——*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly they belong to the leisured and wealthy class; but in reality they are secret agents for a foreign Government sent over to England for the purpose of securing military or naval secrets. Their attention is directed to Summers' work, and they determine to get possession of the airship's plans.*

CHAPTER V. (*continued*).

"Oh, Miss Gwen, but she was very kind to you. She said, 'Miss Thrale mixes in the highest society, you know; quite the highest. I understand, and from a very good source, that a nobleman has offered her his hand and that she has refused. Miss Thrale has rather peculiar ideas, not peculiar but just up to date, though a little *difficile*, you know. But I don't understand modern times. Girls are all skimpy skirts and thin ankles, they swing walking sticks, and they talk like men. Miss Thrale talks like a man sometimes—but there! What her mother would say, poor dear, if she saw her now, I can't think! Mrs. Thrale was a great lady, and she carried herself like a great lady. I never saw Mrs. Thrale in anything but a grey silk; her dresses always swept along the ground, and they took yards of stuff. She gave me one once which she said was no use to her. It made me a beautiful best dress for many years, when I was slimmer. It was the best I ever had, and after I had finished with it as a dress it made me two nice silk petticoats. But Miss Thrale's dresses! why there's hardly enough stuff in them to make a duster. But she is a dear young lady, so kind, so pretty; she always asks me after my sciatica, and sometimes she brings me roses from the Hall. Still, I can *not* make out why she should throw herself away on that young man at the Vicarage.'——But there, Miss Thrale," finally remarked Dupont, "you don't wish to hear all the *bavardage* of an old woman. I will refrain from repeating the comments of so silly an old thing on your personal affairs."

"No, Mr. Dupont, don't stop, please. Do tell me. What did she say about Charles? I know the villagers think him very queer, and they think me queerer still to be engaged to him. But all that is unofficial, whereas old Mrs. Bundross is the mouthpiece of such important local associations as the Mothers' Meeting. I don't go to Mothers' Meetings, and if I did I shouldn't get at the opinion which prevails there, so I'm simply dying to know what she said about Charles."

"Well, Miss Thrale, here we are at the 'Coventry,' and we must go out. But afterwards I will tell you if you want to know."

"Oh, what a pity! The conversation was so interesting. I wish the 'Coventry' were ten minutes further on."

"Never mind, we will continue the *histoire intime* after dinner. It will go nicely with the dessert. But I hope I am not com-

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promising Mrs. Bundross in your eyes. I can assure you she was very nice and very confidential, and I feel myself a little of the *grossier* to give away her confidences; but, after all, what she said to me I expect she do tell to everybody, so I think there shall be no harm done."

"No, no, of course not. It does not matter a straw what the dear old thing thinks or what she says. It only amuses me. I am very curious to hear what she thinks of Charles."

"Well, you see, Miss Thrale, I promise you to do that, but we will eat for our health and drink to your health first."

By this time the cabmen had been duly paid, and the couplets of the party reunited. They made their way, an animated group, into the restaurant, and under the leadership of the Bohemian supped *à la Bohème*. The toast of the guest of the evening was duly proposed and drunk with much applause, and the conversation, which at first was general, became more and more intimate, till at last the party divided itself into two groups, the Bohemian and his "*amies*" talking art and Fabianism in excited undertones, and Herr Beulner, Dupont, and Gwen making another little group at the head of the table. A moment when the conversation lapsed was taken advantage of by Dupont to continue the dissertation on Mrs. Bundross's views.

"Ah, I said I promise to tell you Mrs. Bundross on Mr. Summers. Here it is," and he entered into a brilliant exposition of his subject, so brilliant that Gwen and Herr Beulner were convulsed with laughter. It made the oaken panelled room gay with merriment, and many were the curious glances thrown at this odd party by the diners at other tables. The talkers themselves were oblivious to all this. They were too much engrossed in their subject.

"Oh, Miss Thrale, the old grue do tell the most curious tales about the workshop of Mr. Summers. She do say he in league with the Devil. That he makes a wonderful piano which he plays on for hours and hours."

"Oh, how funny!" ejaculated Gwen. "Fancy Charles playing on the piano for hours and hours. I can as soon see him making mince pies. He has no more music in him than an owl. You should sit behind him in church and hear him sing hymns and you would soon realise how far off the mark poor Mrs. Bundross is. But I expect she has heard tales of Charles's invention. He's wonderfully clever at Wireless, and has rigged up a special machine of his own, though I did not know it was talked about in the village. How do people find these things out? They must spend all their time in watching the movements of other folks."

"Ah, wireless, that is it, Miss Thrale. Mrs. Bundross say that he do take up the new invention, and that he has rigged himself up a telegraph pole which is the most absurd thing you ever saw. She says there are two masts and some queer bits of wire which don't do nothing, and she thinks that he really intended to make a telegraph line and found he could not do it, so left it off in disgust."

"Oh, that's it. Those are the aerials she is thinking of. They do look rather stupid to people who don't know anything about it. But Mrs. Bundross is all wrong about not succeeding. Charles can get messages from Poldhu, and on one occasion I know he got news from Constantinople. But he said that that was a "freak" I don't know what it all means, but I think it shows he knows his business."

"Oh, that is really interesting, Miss Thrale, for our friend Mr. Beulner here *s'y connait*. Of course, he studied it in Germany."

"Yes, Miss Thrale," remarked Beulner, "but I was not satisfied with it, and as I had the opportunity of coming to England with Dupont, I came with the idea of learning something of Marconi. Of course, I have read up all about it, and I have now fitted up a little place at Hampstead, but my station is not very powerful, still I think it would reach to Sotheby. I suppose you could not get Mr. Summers to communicate with me It would be such fun. It would give me practice, and I would learn more after a conversation with him than I could by simply receiving stray messages."

"Well," said Gwen, "I'm sure Charles would be delighted to communicate with you. I will tell him all about it, and perhaps he will."

"But then, Miss Thrale, I'm not quite sure of the new system, and although I know much about it in theory, in practice I am not so certain. I wonder if he would come to my

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place and see my apparatus, or, better still —but I don't know whether I am asking too much—if I were to see his! I could rig mine up on the same plan, and that would make things much more simple."

"Well, I do not see why it shouldn't be done. I am sure Charles would be delighted to help you. Why don't you come down and see us one day? You know the neighbourhood. Say one Saturday afternoon, and you could go over things together."

"And then," chimed in Dupont, "perhaps one day Mr. Summers would do us the kindness to make the exposition of his airship. Oh, yes, Miss Thrale, we know all about it, because we saw it ourselves. We saw it sail across the heavens, and Mrs. Bundross do tell us that it was Mr. Summers' airship. Oh, it was magnificent. It was *tout à fait un objet féerique.* I am dead with envy to see the beautiful airship again."

"Yes, it's a splendid idea! We'll get him to send it off again. Charles loves to show things to people who are really interested, and there are so few of those that any who come his way are welcome. You will be doubly so, for Herr Beulner can tell him all about wireless in Germany; I am sure he would like to know more about the ins and outs of it. So why not fix up for Saturday week? I don't think he's busy then, and the evenings are still long enough to practise in the open. I will tell him you are coming."

"Oh, Miss Thrale, that is very gracious of you; you have already been kind. Now you add to your kindness. We will not forget, and we will be there as you say; but now we have talked long enough. We have tired you, I am afraid, and unless we get you a taxi now you will tire your friends, for it is nearly half-past eleven, and they will be thinking you lost in London, or killed by the motor 'bus. *Garçon, fais venir un taxi.*"

With that the party made preparations to go. Courtesies were interchanged, the invitation and acceptance of Gwen's appointment were renewed. Dupont accompanied her to the taxi, and, after directions had been given to the driver, bid her farewell with a final wave of the hand and a magnificent bow. Together he and Beulner watched the taxi disappear, then Dupont turned to his companion and put his hand on his arm.

"*Voila! nous sommes y arrivés.* Did I not say to you, *mon ami, cherchez la femme.* Haroun al Raschid was no fool when he say that, and I am no fool because I follow the suggestion of Haroun al Raschid."

Beulner emitted a sound which was something between a snort of cynicism and a grunt of satisfaction.

"Ach," he said. "Don't be so much of an optimist. There is many a slip 'twixt cup and lip. By a stroke of luck we have found out the right bait to use for our fish, but I think it is a shy fish and difficult to be caught, and don't forget, too, the hook is wireless, so that the fish, even if we tickle his gills, may escape us."

He laughed at his joke, and Dupont joined in. The Frenchman was much too pleased with his evening's work to pay any great attention to gloomy forebodings.

CHAPTER VI.

IT IS THE UNEXPECTED THAT HAPPENS.

But circumstances ruled otherwise. First of all the airship was the subject of a mishap. It took place in this way. Gwen, on returning to Sotheby the evening following the lecture, paid a visit to Charles in his den, and told him the upshot of her conversation with Dupont and Beulner. To her surprise, her usually placid and benevolent *fiancé* demurred. He said his airship was not ready to show to anybody, and he half hinted that Gwen was abusing her privileges as confidante in giving information to such comparative strangers as these foreigners.

"You know," he said at the conclusion of a very definite speech, delivered while he sat on the edge of the table with his hands thrust in his trousers pockets, "you yourself said you didn't like them, and yet there you are—as soon as you get talking you lose your judgment, and instead of keeping to general topics you must needs discuss my doings with them. That's not what I call the game. I have worked *sub rosa* so far, and now that the thing's nearly completed I am not going to have it blabbed about all over the place. You've taken too much upon yourself this time, my young lady, that's the truth. I shan't . . . ."

"Oh, Charles," Gwen interposed, "do stop talking nonsense; what do you mean by 'working in the dark,' when everybody could see your airship if they wanted to?

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I have not let out any secrets, because you have not told me any. In fact, I think it's a shame. I'm supposed to be your pal, but you don't really tell me anything. You just put me off with some silly 'make-believe,' and all the real interesting part of your work you keep to yourself. Perhaps if I knew *more* about it I should know whether I was blabbing, as you call it, or not. But really, Charles, I didn't tell them anything—they seemed to know it all before; all the village knows it, from what M. Dupont said. Still, what's more to the point—why do you keep everything so dark as though you were afraid to trust me? *That's* not sport, if you like."

Charles was about to defend himself of the soft impeachment, but he was not allowed to.

"Oh, yes, now you'll say I cannot understand. But I *can*, I know I can. And *how* can you tell? You haven't tried to see whether I can or not."

"But Gwen, I've promised to show you."

"Yes, yes, and you'll take a month of Sundays thinking over your promise, and then you'll forget all about it, and I'm to think myself happy to be allowed to know so much."

"But if you did learn to steer the airship, it wouldn't be any good to you."

"How are you to tell—how's anyone to tell, I should like to know? Well, all I can say is, it's not much fun making love to you, if you spend all your time in this smoky little hole, and I'm to be left outside. I don't think I ask much. Many girls would be expecting to be taken to parties and all that sort of thing, but all I have to look forward to is a mild country walk when some part of that miserable little piece of apparatus has been completed."

"No, I own it's rough luck, and I'm beastly sorry I'm such a pig; but you took me unconditionally, you know, and I think I told you what it would be like. Never mind, dearie, I'll try to make amends. You shall begin this game, if that will please you, but it'll be an awfully hard grind, you know. No end of work, and it will be a long time before you can do anything or be any good at it. Only remember, you must make this promise. You are *not* to tell *any* of your friends what I am doing, and as for those chaps Dupont and Beulner, you have got to keep them off somehow."

"There, that's better; you are a dear old thing to give way like that. I know you will be fidgetted to death teaching me, but I think when it's done you will find it much more interesting to have someone to talk the thing over with, and it will give me so much to think of in this dead-and-alive ditch."

"But how about the promise?"

"Oh, I can give that right enough, but you don't expect me to go and tell Dupont that the whole thing about your knowing wireless and airships is a lie, because that wouldn't wash; and as I promised them to see you, I think you will really have to give some sort of show just to make my word good. But I can easily put them off for a bit. All the rest I can honestly promise, every little bit—and you are a dear, dear Charles! I'll make it up to you by learning ever so quickly, and then you'll be glad you have got an apprentice."

"An apprentice who would coax the heart out of a stone, that's what it is, and I'm not a stone, and I'm not an old fogey, so I'm practically bound to give you lessons. But what's the fee?"

What the fee was doesn't matter. It was paid down promptly to the satisfaction of both parties in the compact. Then Charles, raising a somewhat dishevelled head, asked when the first lesson was to be. There was no time like the present. Both agreed, so it was given forthwith.

Now, preliminary lessons are not interesting. They are all facts and figures and axioms and miserable little details that cannot be understood in a hurry. Everything seems so pointless, and none of the practical part to which such knowledge leads is apparent; Charles was therefore anxious to make his teaching as interesting as possible, and so he prepared the airship for a trial spin, thereby hoping to demonstrate certain laws of motion. All went well while he manipulated the machine, but towards the end of the lesson he gave the apparatus into the hands of his pupil in order that she might experiment for herself. Of course, he looked over her, and directed her as much as he could; but the evening was falling, the keyboard at which they were working was difficult to see, and moreover the gloaming is not the time to choose for strictly scientific work, especially when your

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fiancé is leaning over the table frowning at the black and white keys with the nape of her neck so provokingly attractive above the soft ruffles of her collar. What was to be expected happened, and its immediate outcome was the unexpected. There was a little shriek. The keyboard was deserted, the airship was allowed to go its own giddy way, and a sudden vertigo led it to make a brilliant dash for the shed at the bottom of the garden. Scarcely had the shriek and the accompanying laughter of a throaty tenor voice died away before there was a dull thud and the noise of grating steel. Then was the laughter changed to mourning.

"Oh!" from Gwen, and "Damn!" from Charles, was all that was said at the moment, but the silence that followed was—to use an Americanism—thick. It held such a deal of concentrated mental energy that carbon dioxide would be light compared with it. Immediately followed a hurried movement to the scene of the disaster, and what a sight was before the perpetrators of the accident! There on the gravel path by the side of the shed lay the poor airship, its silken envelope deflated and torn, and its shining wires twisted beyond recognition. It looked piteously helpless in its mangled condition, a very mockery of its former glittering pride. Together, would-be professor and pupil took up the remnants and brought them to the table in the den. But it was evident that the damage could not easily be mended. Weeks of trouble would have to be spent before the model could resume its former shape. Summers was not a little vexed at the catastrophe. Here, in one ill-advised moment, he had brought the labour of many months, even years, to nought. Just, too, when he had hoped he was near achieving something great, something more than mere proficience in guiding a toy. All this was knocked on the head. He would practically have to start all over again, and there was no one to help him. Mechanically he picked up the twisted steel bands, and smoothed them out, laying them in a little pile on one side of the table. Gwen watched him do this, with something like remorse tugging at her heart. Why had she interfered in his work? It had all come about through her persistence. She felt herself a very mean little cad, although she knew she was not actually to blame for the disaster. But her dominant sentiment was connected more personally with Charles. She understood exactly how he was feeling. She knew what it was like to have finished a painting, and then to have it spoilt by the varnish; so she quietly tip-toed up behind Charles and gave him a soft consolatory kiss, and squeezed his hand. Immediately he turned round.

"Oh, my dear, it's got to be done all over again."

Then he seemed to shake off his despondency.

"Anyhow," he added, "this settles the question of showing the thing off to Dupont and Beulner. The thing's so absolutely dished that even if the King of England wanted to see it he'd have to wait. Well, it's no good crying over spilt milk. Let's come and get some supper."

That night Gwen wrote to her good friends making all necessary excuses for the postponement of the event. She explained that the thing could not be in working order again for several months, and she carefully worded the letter so that her recipients should have no grounds for construing therefrom any definite invitation for a demonstration in the future.

Dupont, when he got this letter, nearly had delirium. He went up to the sleepy Beulner and nearly shook his head off as he expatiated on the contretemps. "Oh, how this is a *débâcle! Ah, Mon Dieu! Mais il me fait ronger les ongles.*" He was much too excited to talk English, but poured out volumes of the best French known to Montmartre—and very expressive it was! Beulner grunted. He was not so deeply interested as his companion, and his view of the question was that it gave him a little more time in England, and that he liked England.

Whatever else the mishap to the toy may have resulted in, it caused Dupont to write numerous letters to Berlin; not only letters, but telegrams sometimes, and often he would appear greatly worried, even to distraction. There were many causes for such perturbation. Presumably the airship was the chiefest, for hardly a day passed without he made some mention of it to his friend.

But there was another, in the political situation of the moment. Serious friction was reported in the relationships between England and Germany.

(*To be continued.*)

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Answers to Correspondents

By OUR IRRESPONSIBLE EXPERT.

EXPERIMENTER (Grantham).—A quenched spark is a piece of spark squashed flat between two circular brass plates.

* * *

ENTHUSIAST (Park Lane).—We are returning your Postal Order, as we are sorry that we cannot at the moment supply Amateur Installations larger than 2,000 kilowatt. Try Samleigh's.

* * *

INQUIRER (Clapham).—No, continuous waves are not used for ship installations, for the obvious reason that undamped waves only get a few feet off the aerial before they encounter damp waves, which completely spoil the effect.

* * *

PRACTICUS (Southampton).—You are mistaken in thinking there is no difference between "Aerial" and "Antenna." "Aerial" is the term used in ordinary business, and "Antenna" when operators are talking to passengers.

* * *

NEW HAND (Glasgow).—We are interested to hear that on your last ship, using a five-inch plain aerial spark, you were able to jamb a ship fifty miles away. The twenty-three other operators who were held up on the particular occasion are waiting round the Head Office prepared to jamb you at a much shorter distance.

* * *

STUDENT (Edinburgh).—Logarithmic decrement is a combination of Logarithms and Decrement. An explanation of logarithms will be found in any good book on logarithms, and an explanation of decrement in any good book on decrement. We hope this clears away your difficulty.

* * *

APPLICANT (Tooting).—Yes, applicants have to pass rather severe examinations in sending, receiving, auction bridge and dancing before joining the Operating Staff. In some cases, if the examiners think his other knowledge is satisfactory, the applicant may take poker as an alternative to auction bridge, but in no case is a knowledge of Wheatstone bridge any advantage.

* * *

MUSICIAN (Bayreuth).—The music of "God Save the King," which you recently heard in your receiver, was caused by a careless workman at our Chelmsford works attaching a gramophone record to a five-kilowatt set instead of the usual disc discharger. Question two.—Yes, tuning the aerial to the antenna is covered by the Marconi tuning patent Nr. 7777777 of 1777.

* * *

AMATEUR (Manchester).—We are surprised to hear that you have failed to get a good earth by grounding your aerial in a flower pot. We can only suggest that you have the earth in the pot analysed and compared with the lists of Specific Conductivities to be found in the Manuals of Fleming, Erskine Murray, etc. On the other hand, your aerials may be damaged by wireworms. In answer to your second query, yes, it is rather dear at 28s., but then, you see, nobody who has made a trip to sea in charge of a wireless installation ever has the courage to write a book on Wireless Theory; so you will have to put up with what you can get. Question three. To make a good umbrella aerial, stick an old umbrella in a chimney pot and bring the lead down the flue.

* * *

NOTE.—*A number of other replies have been very avoidably held over.*—ED.

"One dot more or less does not often alter the complexion of things, but an extreme example is 'Pop Hearts' for '606 Pearl Street.' It is stated that the operator who performed this feat was in love."—*Telegraph & Telephone Age.*

"Extract from an Official Report:—'Mr. —— has nothing to complain of. It is true he lives close to the office, but he overlooks the fact that we deliver telegrams *four miles in diameter*.' Clearly, wireless will have to be cheapened if it is to carry telegrams of these dimensions. It may even be necessary to institute a supplementary service, aviation, for instance."—*St. Martin's Le Grand.*

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Contract News

Orders have been received from the Greek Government to forward two Marconi landing stations and one automobile station for the use of the Ministry of Marine at Athens.

* * *

The North-Eastern Schools of Wireless Telegraphy have ordered a Marconi 1½-kw. and emergency set, which they are having installed for instructional purposes.

* * *

The Brazilian Government have given further orders to the Marconi Co. for a 5-kw. and emergency set, which is to be shipped out immediately to Rio de Janiero.

The following vessels have been equipped with Marconi Apparatus during the past month.

Ship.	Owners.	Call Letters.	Apparatus.	Remarks.
Katoomba	McIlwraith & McEacharn ..	VKM	1½ k.w. and emergency	—
Isis	P. & O. Steam Navigation Co.	GAP	,,	Passenger vessels sailing between Brindisi and Egypt.
Osiris	,, ,, ,,	GAQ	,,	
Miniro	Tyser Line	MKH	,,	These vessels go eastward to Australia and New Zealand, returning through the South Atlantic.
Whakarua	,, ,, ...	GBZ	,,	
Sardinian	Allan Line	MDN	,,	Passenger vessels between Canada and Glasgow (refitted).
Hesperian	,, ,, ...	MSN	,,	
Kingstonian	Leyland Line, ...	MHM	,,	Trading between Liverpool and Boston, chiefly engaged in cargo transport, but with accommodation for passengers.
Indian	,, ,, ...	MHB	,,	
Columbian	,, ,, ...	MNV	,,	
Montcalm	C.P. Railway	MLZ	,,	Passenger vessel between Canada and Avonmouth (refitted).
Empress of Britain ..	,, ,, ...	MPB	,,	Mail vessel between Liverpool and Canada (refitted).
Belgic	White Star Line	MYD	,,	Passenger between Liverpool and Australia (refitted).
Teutonic	,, ,, ...	MTC	,,	Passenger between Liverpool, Quebec, and Montreal (refitted).
Mashobra	British India S.N. Co. ..	GMS	,,	—
Andania	Cunard Line	GAH	,,	Passenger vessel sailing between Southampton and Montreal.
Bellaventure	Harvey & Co.	VOM	,,	Cruising in Newfoundland Waters.
Bonaventure	,, ,, ...	VOO	,,	Hitherto engaged in seal fisheries.
King Orry	Isle of Man S.P. Co.	MPE	,,	This fleet of mail and passenger boats carries on a regular service between the Isle of Man and Liverpool.
Ben-My-Chree ..	,, ,, ,, ...	MBQ	,,	
Viking	,, ,, ,, ...	MVQ	,,	
Empress Queen ..	,, ,, ,, ...	MEQ	,,	
Huntsman	T. & J. Harrison	GLB	,,	—
Ingoma	,, ,, ...	GDV	,,	South African Trade.
Crown Point	Furness, Withy & Co. ..	GHM	,,	Engaged in North Atlantic service.
Rewa	The Admiralty	MQB	,,	
Rohilla	,, ,, ...	MQA	,,	Engaged in Admiralty transport service.
Dongola	,, ,, ...	MNH	,,	
Plassy	,, ,, ...	MNJ	,,	
Templemore	Johnson Line	MBY	,,	North Atlantic Service (Cargo).
La Marguerite ..	Liverpool & N. Wales S.P. Co.	GJU	,,	Passenger service, Liverpool and Llandudno.
Narragansett	Anglo-American Oil Co. ..	MEC	½ k.w. and emergency	Oil transport.
Katuna	Bucknall S.S. Lines	GEH	,,	—
Kathlambra	,, ,, ...		,,	—
City of Baroda ..	Mail Line	GPC	,,	Part of large contract to fit these passenger vessels sailing between Liverpool, Bombay, and Karachi.
Paris	London, Brighton & S.C. Rly.	GLC	,,	Newhaven and Dieppe Service.
Den of Glamis ..	C. Barrie & Son	GBM	,,	General transport.
Exmouth II. ..	Metropolitan Asylums Board	—	,,	Training Vessel.

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INSTRUCTION IN WIRELESS TELEGRAPHY

Generation of Electric Waves and Construction of the Induction Coil

Fourth Article.

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appears on page 337 of this issue.]

THE methods employed for causing an aerial to oscillate, and thus radiate electric waves, fall under two headings—viz., **Direct Excitation** and **Indirect Excitation.**

In this article we shall deal with only the first of these methods.

29. **Direct Excitation of the Aerial.**—An aerial connected to earth, as shown in Fig. 1,

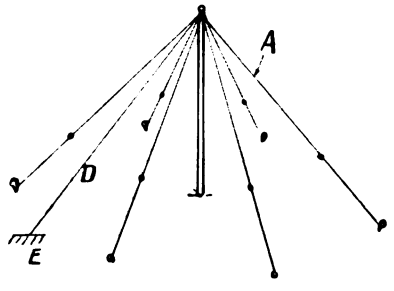

Fig. 1.

is electrically the same as a condenser with its two plates or "sides" connected by a conductor, as shown in Fig. 2. The aerial wires, A, Fig. 1, corresponding to one "side" of the condenser, A, Fig. 2; the earth, E, Fig. 1, corresponding to the other "side" of the condenser, B, Fig. 2, and the connecting wires or "down-leads," C, Fig. 1, corresponding to the short circuiting lead, C, Fig. 2.

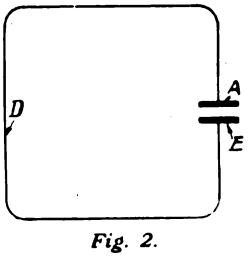

Fig. 2.

Now it has already been explained (paragraph 26) that if a condenser be charged up and then short circuited, the charge of electricity will not immediately come to rest, but the condenser will over-discharge itself, and the current will oscillate backwards and forwards until, owing to the resistance of the path of discharge, the charge of electricity comes to rest.

In order to cause a circuit, consisting of a condenser short-circuited by a wire to oscillate, it is, therefore, only necessary to give the condenser an initial charge of electricity, and to do this we must apply a "voltage," or pressure, of electricity across it.

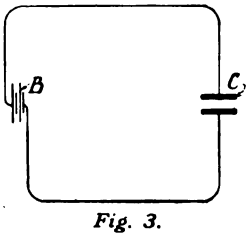

Fig. 3.

This can be done by connecting a battery across the condenser, as shown in Fig. 3, which will charge the condenser up to the same voltage as the battery; but in applying a voltage in this way to a condenser, whose two "sides" are connected together to form an oscillating circuit, as shown in Fig. 2, the electricity, instead of charging up the condenser as desired, will simply flow through the short-circuiting wire, C.

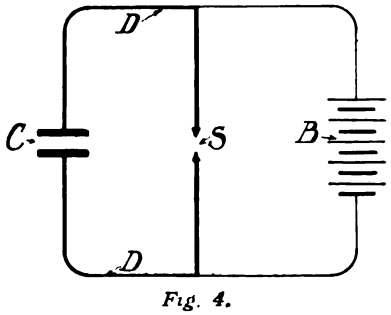

Fig. 4.

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It is, therefore, obvious that during the time the condenser is being charged, we must break the circuit through the short-circuiting wire, as shown in Fig. 4, at the point marked S.

This, however, destroys the oscillating circuit, as it prevents the discharge of the condenser through the circuit, C, which discharge is required to produce the oscillations.

In order, therefore, to get the conditions right, both for charging up the condenser and for discharging it through the circuit, C, it is necessary to devise some form of mechanism for automatically breaking the discharge circuit and connecting the battery to the condenser at one moment, and then "making" the discharge circuit and "breaking" the battery circuit at the next moment.

This method is not used in practice, as, apart from the fact that it would be somewhat complicated in operation, an additional drawback arises in that a very large battery would be necessary in order to charge the condenser up to a sufficiently high voltage to store up the energy that is required.

It should be here explained that the power in any oscillating circuit depends upon three things:

(1) The capacity of the condenser.

(2) The number of times per second that it is charged and discharged.

(3) The initial voltage to which that condenser is charged.

As already explained (paragraph 28), the capacity of the condenser is limited by the wave-length it is desired to produce.

Further, the number of times per second it can be charged and discharged is limited by other practical considerations, which will be dealt with later, so that the only method we have of increasing the power in the oscillating circuit we are considering is by increasing the voltage applied to the condenser.

As the object of these articles is to explain the working of a small portable station, we will only consider the apparatus that would be used in such a station.

The wave-length would be probably about 150 metres, and the aerial used for such a station would probably consist of about six wires, each wire about 75 feet long, supported at the common end by a mast about 30 feet in height; such an aerial, known as an "umbrella" aerial, is shown in Fig. 5.

The capacity of this aerial would not be more than about ·0005 of a microfarad, and

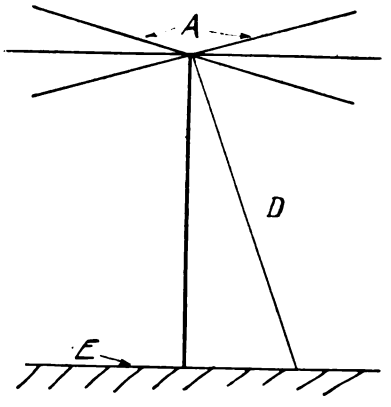

Fig. 5.

assuming that we charge it and discharge it at the rate of 100 times per second, the initial voltage to which it would have to be charged in order to use up 20 watts of power would be about 20,000 volts.

To charge up this condenser to 20,000 volts by the method described in the preceding paragraphs would require a battery of about 1,400 dry cells or 1,000 accumulators, which shows how impracticable this method would be.

Our problem, therefore, becomes how to obtain a voltage of 20,000 volts by some method which will not be either too costly or too elaborate.

30. **How to obtain a voltage of 20,000 volts by means of an induction coil.**—In paragraph 3 we explained briefly the principle of a transformer and induction coil, and we showed that if a current flowed round a piece of soft iron, that piece of iron became a magnet so long as the current was passing round it, but as soon as the current ceased to flow the iron became demagnetised. We also showed how, if another coil of wire were wound round the magnet thus formed, a current of electricity would be induced in this secondary coil.

Now the voltage, or pressure, of the electricity induced in this secondary coil depends upon two things:

(1) The **rate of change** in the number of

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magnetic lines of force which pass through the secondary coil.

(2) The **number of turns of wire** with which the secondary coil is wound.

The quicker the rate of change in the number of magnetic lines of force the greater

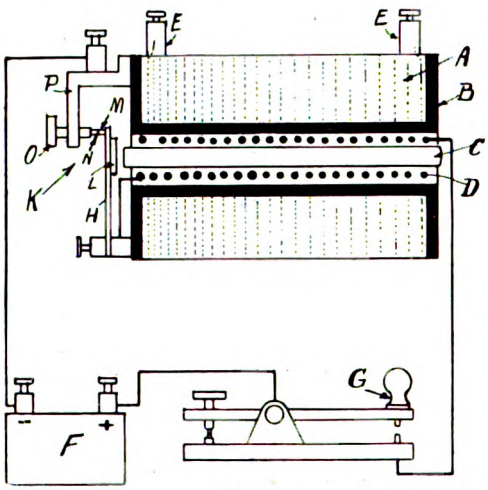

Fig. 6.

the resultant voltage across the secondary coil. Also the greater the number of turns in the secondary coil the greater the resultant voltage across it.

By using a very fine wire in the secondary coil we can wind a very large number of turns in a small space.

31. **Construction of an Induction Coil.**—We may now describe how an induction coil is actually made, and the means by which it can give automatically a continuous stream of high-voltage impulses, or sparks, when a low-voltage battery is applied to its primary terminals.

The mechanical construction is shown in section in Fig. 6, and the electrical connections are shown diagrammatically in Fig. 7.

The secondary coil, A, is wound with about 5,000 turns of fine wire on an ebonite bobbin, B, the bobbin having a hole through the middle sufficiently large to take the primary coil with its iron core, the two ends of the secondary coil are brought one to each of the terminals, E, E, which are called the high-tension terminals of the induction coil.

The iron core, C, is made of a bundle of very soft iron wire, bound together with cotton tape, and round this core is wound the primary winding, D, consisting of about 25 turns of fairly thick wire, through which the current from the primary battery has to pass in order to magetise the iron core. One end of this coil is taken straight to the positive terminal of the battery, F, through the manipulating key, G. The other end of the coil, however, instead of being connected straight to the negative terminal of the battery, F, is connected to the spring arm or trembler blade, H, of the contact breaker, K.

This trembler blade carries on its lower side a small piece of soft iron, L, and on its upper side a platinum contact, M. Another platinum contact, N, is carried on an adjusting screw, O, by a brass bracket, P, in such a way that it comes immediately opposite the contact, M, the spring of the trembler blade being adjusted so that normally the two contacts M and N, are making contact. The brass bracket is connected to the negative side of the battery, F.

The action of the coil can best be followed by referring to the diagram of connections in Fig. 7, the contacts, M and N, being in contact if the arm of the manipulating key, G, is depressed, the electrical circuit through the primary coil is completed and a current will flow from the positive side of the battery, F, through the manipulating key, G, through

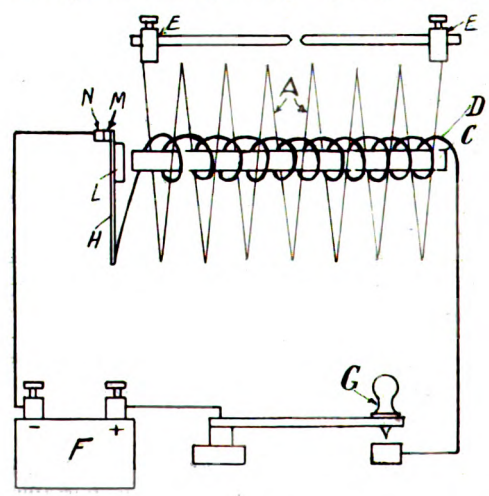

Fig. 7.

the coil, D, through the trembler blade, H, through the contacts, M and N, through the bracket, P, and back to the battery, F.

The effect of the current passing through the coil, D, is to magnetise the iron core, C, and the first effect of this magnetisation is to

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induce a voltage across the secondary coil of wire. This high voltage, however, is only a momentary impulse, for it depends, as already stated, upon the rate of change in the number of magnetic lines of force passing through the secondary coil, so that as soon as the iron core is fully magnetised by the primary current, the *change* in the number of magnetic lines ceases, and therefore the voltage across the secondary falls to zero.

If, however, the primary current flowing round the iron is interrupted, the iron core becomes demagnetised, and there is again a rapid change in the number of magnetic lines of force passing through the secondary coil, and we get a second high voltage across the secondary coil.

Now this interruption of the primary circuit is effected automatically by the contact breaker, for as soon as the iron core becomes magnetised it attracts the piece of iron, L, Fig. 7, which, as already explained, is fixed to the trembler blade, carrying the contact, M, thus separating the contact, M, from the contact, N, and interrupting the primary circuit.

As soon as the circuit is thus broken, the iron core, C, ceases to be a magnet, and therefore ceases to attract the piece of iron, L, allows it to fly back to its original position, and the primary circuit is again completed through the contacts, M and N, coming together again.

The same cycle of events repeats itself in rapid succession so long as the manipulating key, G, is kept depressed.

The resulting effect in the secondary coil is, therefore, a corresponding number of high voltage impulses across the coil, one impulse being induced when the magnetism in the iron grows owing to the primary current passing around it, and a second impulse being induced in the opposite direction when the magnetism of the iron collapses owing to the primary current ceasing to pass around it.

As a matter of fact, the magnetism in the iron grows comparatively slowly as compared with the rate at which the magnetism collapses on breaking the circuit, and as the voltage across the secondary coil is proportional to the *rate* of change of magnetic lines of force, we get a very much bigger voltage during the collapse of the magnetism than during the growth of the magnetism : that is to say, we get a higher voltage when the primary circuit is interrupted than when it is completed.

Fig. 8 shows diagrammatically the voltage induced across the secondary of an induction coil. The upper part of the curve shows the voltage impulses due to the making of the primary circuit, and the lower part of the curve showing the voltage impulses due to the breaking of the primary circuit.

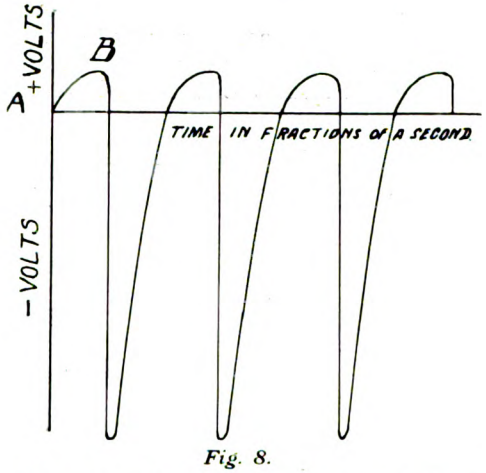

Fig. 8.

From A to B the magnetism in the iron core is growing comparatively slowly, and the voltage induced across the secondary only rises to about 1,000 volts.

At the point B the primary circuit is broken, and a very high voltage, namely, about 20,000 volts, is induced across the secondary in the opposite direction owing to the very rapid collapse of the magnetism in the iron.

32. **Application of a high voltage to an oscillating current.**—Having shown how we can obtain a high voltage by means of an induction coil, we must now study the application of this high voltage to a simple oscillating circuit.

We showed how, in the case of a low voltage battery being used for charging the condenser, it would be necessary to make some form of mechanism which would alternatively make or break the battery circuit or the discharge circuit.

In the case of an impulsive high voltage generator, such as the induction coil just described, such mechanism can be dispensed with by making use of other phenomena observed with high voltage currents.

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Air in its normal state is nearly a perfect insulator: that is to say, for all practical purposes it will not conduct electricity. If, however, a sufficiently high voltage is applied across an air space the insulation of the air is broken down, allowing the current to pass through the air space, causing a spark to occur, and the effect is to make the air space momentarily into a conductor.

Further, once the spark is formed it will be maintained by a very small current, even though the voltage across it drops to a very small value, but as soon as the spark ceases the air space returns to its normal state of insulation.

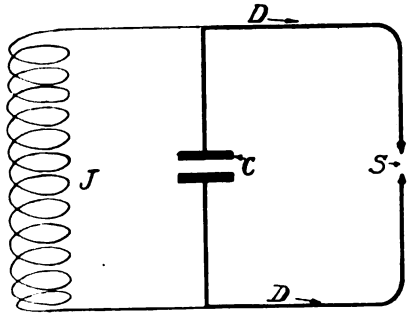

Fig. 9.

By applying this phenomena we can construct an oscillating circuit such that during the time that the condenser is being charged the short circuiting wire is broken by an air gap, but as soon as the voltage across the condenser rises to a certain maximum, depending upon the length of the air gap, the insulation of the air gap is broken down, a spark occurs across it, and for the moment the gap, instead of being an insulator, becomes a conductor and allows the condenser to discharge itself as though the short circuiting wire were not broken.

As already explained, the condenser not only discharges itself, but over-discharges itself, and the current oscillates backwards and forwards a number of times, until, owing to the resistance of the short circuiting wire and the spark gap, the oscillations die down, until the current flowing is not sufficient to maintain the spark. The spark then goes out and the air gap assumes its normal insulating properties until the next high voltage impulse is applied to the condenser, when the same cycle of events takes place.

Such an arrangement is shown diagrammatically in Fig. 9, where A is the secondary of the induction coil, B is the condenser, C the short circuiting wire, and D the spark gap.

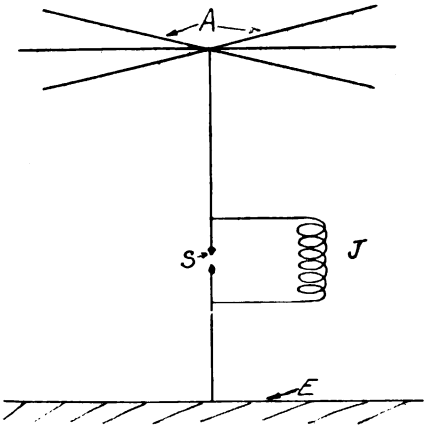

Fig. 10.

Up to the present we have been considering the method of excitation as applied to the closed oscillating circuit shown in Fig. 2, but as this is equivalent to the aerial shown in Fig. 1, it is obvious that this method of direct excitation can be applied equally as well to an aerial or open oscillating circuit. Such an arrangement is shown diagrammatically in Fig. 10, where A is the secondary of the induction coil, B is the aerial or antenna, C the earth, and D the spark gap.

An aerial directly excited in this manner is usually called "plain aerial," and is extremely efficient for obtaining compara-

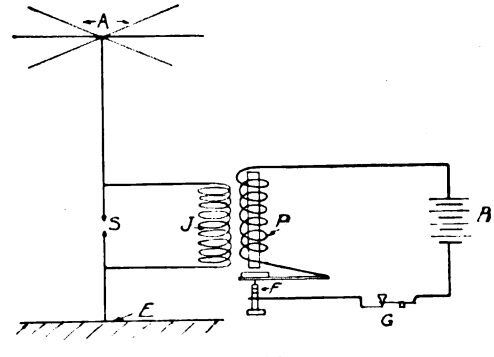

Fig. 11.

tively long range with the use of a small power.

A complete diagram of connections of such

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a transmitter is shown in Fig. 11, where A is the aerial, B the earth, C the spark gap, D the secondary of the induction coil, E the primary of the induction coil, F the contact breaker, G the manipulating key, and H the battery.

Our Prize Scheme

The articles which are at present appearing in THE WIRELESS WORLD in connection with our scheme of instruction in wireless telegraphy have aroused a great deal of interest among those who are qualified to sit in examination for the valuable prizes and certificates which the Marconi Company have generously offered to candidates who pass the approved test. Full particulars of the prize scheme were announced in our April and May issues, in the first of which we published letters from Lieut.-General Sir Robert Baden-Powell and Major-General Edward C. Bethune, cordially approving the scheme. The articles (of which the fourth appears in this issue) have been so framed that anyone having no previous knowledge of electricity will be able, if the articles are followed carefully each month, to understand fully the practical working of a portable wireless telegraph apparatus, in theory and practice, and with a little experience in working will be able to operate such a set successfully.

Those competing for prizes will be divided into three categories :—

1. Members of Territorial units and recognised cadet battalions.

2. Members of Church Lads' Brigade and Boys' Brigade, and recognised cadet corps.

3. Members of the Boy Scouts Association.

The series of articles will be completed probably in March, 1914, when examinations will be held under proper supervision for those in the above categories who wish to offer themselves.

On the result of this examination proficiency certificates will be given by the Marconi Company to those qualifying.

The following prizes will also be awarded :

(1) Territorials and Cadet Battalions.—1st prize, 10 guineas ; 2nd prize, 5 guineas ; 3rd prize, 2 guineas ; and 5 prizes of 1 guinea each.

A complete set of field station wireless telegraph apparatus will be given to that unit to which the first-prize winner belongs.

(2) Boys' Brigade, Church Lads' Brigade, and Cadet Corps.—1st prize, 3 guineas ; 2nd prize, 2 guineas ; 3rd prize, 1 guinea ; and 10 prizes of 10s. 6d. each.

A complete set of field station wireless telegraph apparatus will be given to the unit containing the first-prize winner.

(3) Boy Scouts Association. — 1st prize, 3 guineas ; 2nd prize, 2 guineas ; 3rd prize, 1 guinea ; and 10 prizes of 10s. 6d. each.

A complete set of field station wireless telegraph apparatus will be awarded to the troop to which the first-prize winner belongs, and another set to the troop obtaining the highest percentage number of certificates of proficiency, irrespective of prizes.

Further details as to date and places of examination will be published in course of time in THE WIRELESS WORLD.

Those who have not yet applied themselves to the study of the series of articles which commenced in May last should apply immediately for back numbers of this magazine (May, June, and July), and lose no further time in taking up the subject. The prize-winners will not only enrich themselves, but some of them will place the units or troops to which they belong in the enviable possession of a complete wireless telegraph station. Apart from the prizes and certificates, every student of our course must derive some personal advantage from the knowledge that he gains.

The Admiralty have placed with Messrs. Samuel Baikie & Son, Kirkwall, the contract for the erection of the buildings for a wireless station at Brough Head, South Ronaldshay, Orkney. This station is part of the work in the Orkney Islands for which a vote of £20,000 is included in this year's Naval Estimates.

The erection of this station will bring "the adjacent islands of Great Britain" a little nearer. The inhabitants of Ronaldshay, where the station is to be erected, only heard of Queen Victoria's death on the day before the funeral. But in St. Kilda it was worse at one time of day, for St. Kilda history records that the ministers on the western island were still praying for George IV. when Queen Victoria came to the throne.

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HINTS FOR AMATEURS

A Long Distance Amateur Station

By P. S. X.

THE aerial for long distance receiving is of the ordinary flat ship station type, consisting of four wires of No. 16 gauge single strand copper wire spaced at 4 feet apart, and each wire 240 feet long, each end being insulated by porcelain insulators and also a long stick of round wood impregnated with shellac varnish. The average height of this aerial is 45 feet, one end being 60 feet and the other 30 feet; the high end is connected to the instruments and the wires at the lower end all free.

The aerial for sending and short distance receiving is of the 6-wire cylinder type, hung at an angle of about 25° to the vertical and 40 feet long, the lead-in wires being taken from the lower end to a plug board in the instrument room. The natural wave-lengths of the two aerials are 520 metres and 120 metres respectively. The lead-ins are taken into the cabin through ebonite tubes, thus perfectly insulating them from the earth. Now that the description of the aerials is completed, it will be best to consider the receiving instruments next.

Detectors.—The first and most essential instrument is, of course, the detector. There are five of these in a bank, with shorting switches and connecting switches arranged in the following way. All the cups holding the crystals are all connected together, and under each cup is a brass screw penetrating to the inside of the mounting board; against this screw presses a fairly strong piece of strip spring brass, connected at one end electrically to the main pillar of the detector *B* in Fig. 1. Now in front of the detectors is a long piece of strip brass with a hole drilled into it exactly in front of each detector in such a way that when a long brass plug is inserted it penetrates into the interior of the box and pushes the spring S away from the cup screw C, and thus unshorting the detector; and as the terminals are connected, one to all the detector cups and the other terminal to the brass strip A, it is obvious that it also will connect the pillar B of the detector in circuit; thus we unshort the detector and connect it in circuit in the same operation. And unless the plug is in place in the detector wanted they are all shorted and disconnected.

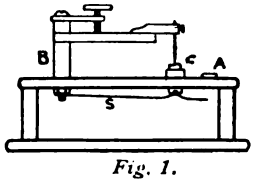

Fig. 1.

The crystals used are two galena and two silicon and one universal stand for testing various crystals. The advantage of having two of each type is that one can be made to work better than the other, and *vice versâ*, thus obtaining a perfect adjustment; if you feel that you have one adjusted you have no compunction in trying to better the other one, and so on. The galena crystal has a very light copper spring of No. 32 gauge wire resting lightly on it, while the silicon has either a rounded blunt brass or steel point resting on it with a very delicate adjustment.

Tuning Instruments.—The tuning arrangements consist of two loose-coupled transformers and one double-slide tuning coil. One of the transformers is for long waves up to 3,000 metres, and the other one tunes only to 800 metres, which is very convenient for the reception of short waves. The primary is varied on both transformers by means of the well-known slider arrangement touching one wire at a time, thus getting more efficient working. The primary wires are of No. 20 gauge copper enamelled wire, and the secondaries are No. 28 enamelled wire taken off in sections to a point switch placed on the end of the secondary coil. The secondary slides in and out of the primary on two brass rods, thus very easily altering the coupling. The diameter of the primary in the large transformer is 4¼ inches, and wound 11 inches long; the smaller one is 2½ inches diameter, and wound 4 inches long.

The double slide coil is about 2½ inches diameter, and wound 10 inches long with No. 22 enamelled copper wire.

Variable Condensers.—The variable condensers used with the above transformers are of the rotary plate type, with press-pahn paper used as the dielectric. There are two of these condensers, each of ·002 microfarads capacity. One is placed across the secondary winding of the loose coupler and the other can be placed either across the primary winding for the reception of long waves or in series with the ground for short wave stations. Protractors serve very well as indicators for the amount of condenser inserted.

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Telephone Condenser.—There are three different types of telephone condensers, any of which can be used at will for the purpose of experimenting. One is a glass plate tinfoil, fixed capacity, another is a paraffined paper and tinfoil, and the third is a paraffined paper,

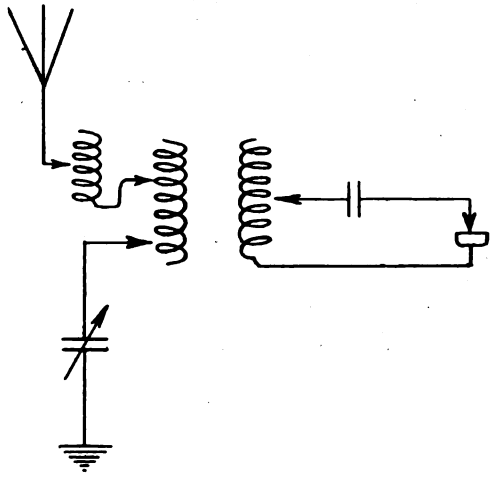

Fig. 2.

unit type, varying from ·00002 to ·008 microfarads by means of inserting plugs.

Telephones.—These being of a well-known American make and of a total resistance of 2,000 ohms per pair. I have tried many 'phones, and I have never yet found a better pair than the "Murdoch" 'phone, being fairly cheap and very comfortable to wear for long periods of listening in.

Loading Coil.—There is one large loading coil made in two sections, each tuning 3,500 metres; thus, with it in series with the aerial, a very large wave-length may be received. In addition to the instruments, there are several switches and an aerial plug-board for using either aerial on receiving or sending at will, and also for grounding the aerials when not in use. Another switch is provided for changing tuning instruments quickly.

There is also a complete portable set, which includes all the instruments required for efficient reception, viz., loose coupler, one variable condenser, one galena and one silicon detector, fixed telephone condenser, head telephones and a test buzzer, all mounted in a case with a box cover. This set may be seen in the lower left-hand corner in the photograph.

This practically finishes the receiving instruments, and a few words may now be said about their power.

Most stations within a fairly large radius have been received, the farthest being the Marconi station at Las Palmas in the Canary Islands. This has only been received a few times, and, I think, only on freak nights, but the station at Cadiz can be heard working quite clearly every night on 600 metres; and stations such as Soller, Algiers, Pola, Barcelona, Aranjuez, Madrid, Rochefort, Bergen, Crookhaven, etc., are easily received all the time. Paris can be heard easily with the telephones about 4 feet away from the ears, and Cleethorpes with 'phones about 8 feet away. Clifden is quite loud. Seaforth, which is only a few miles away, is, of course, deafening, and can be heard with 'phones 16 feet away quite easily. Ship stations are received about 1,100 miles away, and have occasionally been heard in the Mediterranean, but very seldom, and only when the detectors are working perfectly. The receiving diagram is shown in Fig. 2, and I find this works best for this station.

The Sending Instruments are at present rather roughly made, being only knocked together before new ones are made.

The spark coil is an ordinary motor cycle ignition coil with an extra screw fitted to the trembler so as to give a very high trembler speed, thus giving off a very high note in the

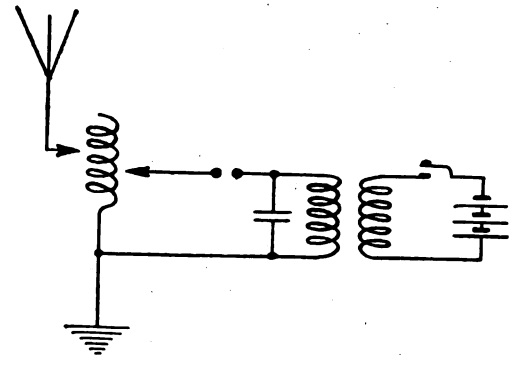

Fig. 3.

spark. As the trembler is high speed, more current can be used, thus giving greater distances; this is generally 8 volts 2 amperes, and occasionally 12 volts 2 amperes.

The Spark Gap is of zinc, turned with a spherical face. The tuning is effected by a

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helix of No. 8 copper wire wound on an 8-inch drum. This gives a variation from 50 metres to 235 metres, and gives quite a sharp, definite wave. The condenser is of the Leyden jar type, consisting of two pint jars. The connections used in the transmitting circuit are shown in Fig. 3.

There is a difference of opinion as to the best type of instrument to use. I have tried several different types of crystal and liquid detectors, but I have never found any one better than the galena with a light copper spring resting on it.

There is also much difference of opinion as to the best size wire to wind a loose coupler. This, again, depends on the station, and must be experimented on until the best results are obtainable.

AMATEUR NOTES.

"A Long-Distance Amateur Station."

WE have printed the above article as we received it, and we welcome it as an example of the kind of contribution suitable for our Amateur Section. At the same time, it must not be thought that we approve of everything we publish in such articles; for instance, we feel inclined to protest against the introduction of certain Americanisms, such as Loose-Coupler—awful word—and Loading Coil. Wireless telegraphy has a sufficiently good vocabulary of its own, developed by its English pioneers, to manage without borrowing from other people. An oscillation-transformer is the strictly correct word for the former piece of apparatus, and if the colloquial term, "Jigger," is hardly more elegant etymologically than the "Loose-coupler," it is at any rate sanctified by constant use by the men who have made wireless what it is. And "Tuning Inductance" or "Variable Inductance" is surely a better term than "Loading Coil."

We notice also that P. S. X. carries his Trans-Atlantic tendencies to the point of using an auto-transformer in his transmitter. And, by the way, where is his telephone-receiver in the sketch of the Receiving Circuits? We approve of his plan of using duplicate detectors so that "no compunction may be felt in trying to better the other one" while in the act of reception. On the other hand, we think that if he were to keep a good Carborundum crystal, with a properly-adjusted battery and potentiometer, always going as a "stand-by," this would take the place of the various duplicates.

* * *

London has hitherto been without a wireless club, but at a meeting held on July 5th an association was formed under the title of "The London Wireless Club," having for its object "the bringing together of all amateurs interested in wireless telegraphy and telephony." At that meeting Mr. R. H. Klein, of 18, Crediton Road, West Hampstead, N.W., was elected Hon. Secretary *pro tem.* The next meeting will be held in September, and in the meantime amateurs intending to join the club should communicate with Mr. Klein. We are glad to learn that already sufficient support has been given and promised to ensure the success of the club.

* * *

The Cheshire Radiographic and Scientific Society started with the intention of limiting its membership to 17, as the headquarters (Sale) is a private house. But the movement

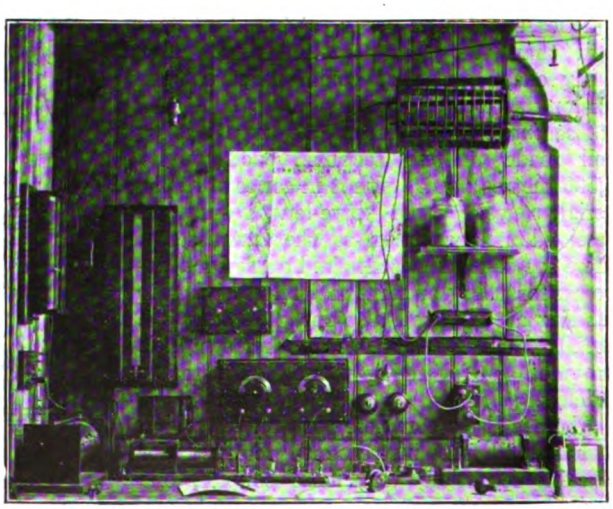

Fig. 4. Receiving Apparatus, P. S. X.'s Station.

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has grown rapidly, and so many applications for membership have been received that it is proposed to obtain suitable headquarters, and to accept further members. The society will hold a public exhibition in the autumn.

* * *

The Newcastle and District Amateur Wireless Association was formally established at a meeting held on July 8th. The number of members enrolled is satisfactory for a beginning, but the association is appealing to "*bona fide* experimenters" in the district to join its ranks. A committee has been formed to arrange for a club-room and station, and soon the association hopes to be established in convenient headquarters. A temporary executive has been appointed consisting of Mr. Collard, Chairman; Mr. Mann, Treasurer; and Mr. C. M. Denny, of 24, Eversley Place, Heaton, Newcastle-on-Tyne, Hon. Sec.

* * *

The Northampton and District Wireless Club, which was recently formed, has a membership exceeding forty. A meeting was held at the Y.M.C.A. rooms on July 2nd, over which Mr. F. H. Wright presided. During the course of the discussion, suggestions were made for the establishment of a station and club library, and it is expected that when the headquarters of the club have been definitely decided upon (probably within the next month or two), the installation and library will be a feature. The secretary of the club is Mr. E. H. Coleman, of 90 St. James' Park Road, Northampton, who will be glad to hear from gentlemen in the district interested in wireless telegraphy.

* * *

At a meeting of the Liverpool and District Amateur Wireless Association, held on July 3rd, it was announced that Colonel W. H. Walker, M.P., had consented to become the first President of the Association, and that he had given the club substantial financial assistance. The Hon. Secretary reported the results of some experiments carried out on the River Ribble, at Clithero. The question of efficient safeguards against lightning was discussed, and the opinion was expressed that in the case of a high aerial all metal guy ropes should be earthed through a two-way switch with a wide break, so that in addition to the aerial being short-circuited to earth, the instruments themselves would be entirely disconnected, with a break sufficiently wide to prevent arcing. The receiving circuits should also be provided with a well-designed lightning arrester. A description was given of a compact type of receiving set suitable for portable use, which, though only wound with little wire, is capable of bringing in long wave-lengths. There are no sliding or other contacts with this set.

* * *

Capt. Fuller, R.E., recently lectured on wireless telegraphy in the College Hall, Liverpool. He showed various lantern slides of Army field stations, and not the least interesting part of his lecture was the practical advice offered to amateurs as to arrangement and construction of the apparatus. At the close, the visitors inspected the college installation. This has been fitted up by Mr. Robert W. Sloley, with the help of some of the college boys during their spare time, most of the apparatus having been constructed in the physical laboratory.

* * *

Nearly three hundred amateurs have taken the Government Wireless examinations at the Brooklyn Navy Yard, and have been given licences to operate stations in the vicinity of New York. All such stations have been assigned calls beginning with the figure "2" followed by two letters of the alphabet, thus: "2AB," "2AC," etc. It is unlawful for such stations to use any call other than that named in the Government licence.

* * *

At the Imperial Scout Rally, which was held in Birmingham in July last, eight troops entered the wireless competition. Communication was maintained throughout the week between two small stations five miles apart. Both stations worked very well considering the difficulties, but it was evident that the boys have still much to learn to enable them to attain proficiency. We would strongly urge upon them to study the course of articles now appearing in THE WIRELESS WORLD.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

S. B.—*Tuning Coil.*—The tuning coil I am making consists of a cardboard cylinder 12 in. long, 4 in. diameter, with two wooden ends 4½ in. diameter. The cylinder is wound with one layer of No. 26 enamelled wire. The bar for the slide is fixed across the heads. 1. Must the cylinder be left hollow, or is there any iron core put inside? 2. Must the enamel be scraped off where the slide makes contact with wire as it is slid along? I am using the old-fashioned coherer, with an electric bell at the receiving station. 3. Can I use a tuning coil and crystal detector in place of coherer, with just the ordinary bell, without having to buy telephones, as they are expensive?

Answer.—1. Yes; the iron core would be worse than useless. 2. Certainly. 3. No; quite impossible. You must make up your mind to get hold of a telephone of some kind; if you cannot get a high-resistance one, you might use a low-resistance one, and find an old scrapped motor-car ignition coil to use as a telephone transformer. (See countless replies in earlier numbers of the WIRELESS WORLD.)

P. J. P.—*Compass Aerial, etc.*—Will you explain the following: (1) How the "Compass" aerial is slung when the ship carries an ordinary commercial aerial as well? I am familiar with the construction and working particulars of the "compass" aerial and accessories, but do not know how it is kept clear of the commercial aerial. I have an idea it is slung much lower down, from a cable stretched from a point about half-way up the foremast to one of the smoke-stacks. Is this so?

(2) What are the names of the radiophares now working, or under construction, on the French coast? (3) Are there any working or proposed in Great Britain? If so where?

Answer.—(1) The "compass" aerial is suspended either from a stay between masts or from a bracket fixed to one mast. In either case its level is lower than that of the commercial aerial, some 3 or 4 feet spacing being allowed. Sometimes it is supported from a stay sloping between the top of a smoke-stack and a point high up (not half-way down) one mast. (2) Creach de Ushant, Ile de Sein, Havre. (3) No.

T. F. N.—*Receiving Inductance.*—I have constructed an ordinary two-slide receiving inductance, the dimensions of the helix being about 52 cms. long, 13 cms. in diameter, and approximately fifteen turns of wire per centimetre of length of coil, the wire being No. 22 s.w.g. enamelled copper. I wish to calculate the inductance of this. Is the following the correct formula to use, or is it meant for a helix of considerably greater comparative length?

$$L = l\,(\pi D\,N)2$$

Where N = number of turns per cm.
D = diameter in cms.
l = length of helix.

I presume this gives the inductance in centimetres. How can the inductance in henries be calculated? What is the definition of a "henry" in comparison with other electrical units?

Answer.—The formula will be successfully accurate. Yes, it gives the inductance in centimetres. Divide by 10^9 to reduce to henries. When, in a circuit, a current varying at the rate of one ampere per second produces a back E.M.F. of one volt, that circuit is said to have an inductance of one HENRY. The usual unit of inductance in wireless is the MICROHENRY, one-millionth of a henry—and therefore equal to a thousand centimetres.

X. Y. Z.—*Crystal Work.*—I have a small wireless installation, and receive from Nordeutch, Poldhu, Cleethorpes, Paris, etc., etc. Could you please tell me why I get Paris, Bolthead, and many others on one place, and Nordeutch, Cleethorpes, Whitehall, and Poldhu, and most other stations on another. Is it owing to the resistance in the crystal? I have trouble in adjusting my silicon. Is there any other crystal I could use to give me the same results, but easier to adjust. I do not wish to use a battery in my circuit, as I have had enough bother with it. Also, why is it that even when I have the crystal well adjusted, and am waiting for F.L., I get nothing through until I pass a current through the circuit, and then it comes through as usual?

Answer.—You must be more explicit before an answer can be given to your questions. You give no possible clue as to what "one place" may mean. Is it on the aerial tuning inductance, the aerial tuning condenser, the jigger-secondary, the coupling, or some particular place on the crystal? We do not sympathise with you in your remarks about the use of a battery for crystal work. A battery and potentiometer are no trouble if arranged properly; and, as a matter of fact, we are not inclined to recommend any crystal except Carborundum, which requires them. Carborundum is robust, stable, sensitive, and easy of adjustment. Your last question is equally ambiguous. Do you mean that you can get no signals from F.L. to "come through" until you have passed a *momentary* current through the crystal, or that you keep the current flowing? In any case, we are surprised, our experience being that F.L.—at such a short distance, as at a receiving station in England—will come through almost anything; in fact, it is said to have come through a bedstead.

W. S.—*Wave Lengths.*—We are told that the natural wave length of an aerial is approximately 4·5 times its total length. How are the words "total length" to be construed in the case of a T-shaped aerial? I take it that the wave length of this would be the same as that of a L-shaped aerial, *i.e.* the wave length is practically unaltered by the addition of the second arm of the T. If the two free ends of the T are at different heights from the ground, will the fact that the two arms have different capacities mean that sharp tuning for radiation will be rendered impossible? I am using a zincite-pyrites detector and 3,000 ohm 'phones, and obtain signals from F.L., K.N.D., etc., just loud enough to be comfortably readable (with my present aerial). Would it be possible to work a non-polarised relay in conjunction with a Lodge-Muirhead wheel coherer, and obtain satisfactory records?

Answer.—You are right in supposing that the natural wave-length of a T aerial is nearly the same as that of an inverted L aerial formed by removing half the cross of the T. More accurately, it is equal to that of a "twin" inverted L aerial of the same length as the half T. If the free ends of the T are at different heights from the ground, the two arms will certainly have slightly different capacities, but this will largely be compensated for by the fact that

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their inductances will be different in the converse proportion, so that the natural wave-lengths of the two branches will not differ by more than very little, if at all. You might make sure of this with a wavemeter, and if there is an appreciable difference, adjust to equality by cutting off a little of one branch. It is certainly important that each should have the some wave-length. If your signals are only "comfortably readable" on a zincite-pyrites receiver, we fear there would be no chance of your getting a Lodge-Muirhead coherer to work a non-polarised relay.

BRUM.—*Continuous Waves.*—I read that a succession of continuous waves would not be audible in the phones of a receiver owing to their inaudibly high frequency, and are therefore split up into groups, and the phone diaphragm oscillates at the frequency of the groups only. How is it that in the latter case the diaphragm no longer oscillates at the wave frequency of each group, and does not give, as I should have expected, a rapid succession of high notes? Does this breaking up also cause each group to have only one effective wave, thus giving one diaphragm oscillation per group?

Answer.—No wireless waves, either continuous or non-continuous, make the telephone diaphragm vibrate to the wave-frequency. In the first place, no diaphragm has yet been made which would vibrate at the rate of fifty thousand per second—the wave-frequency of the slowest waves in use; and, in the second place, the impedance offered by the coils of the telephones to alternating currents of such frequencies would be so great that the current passed would be too small to operate the telephones. This is where the "detector" comes in, performing the function of rectifying the oscillating currents into pulses of uni-directional current. These pulses are used to charge up the telephone capacity, and this discharges through the telephone coils. In the case of non-continuous waves, which are sent out in wave-trains either separated by periods of inactivity (see diagram on p. 167 of the June issue of THE WIRELESS WORLD) or waning to zero and then increasing again, each wave-train is converted by the detector into a group of uni-directional pulses, which add up in the telephone-capacity, and then, discharging through the telephone-coils, produce a single movement of the diaphragm. Thus each wave-train produces a movement of the diaphragm, and the several trains, which form a "dot" or "dash," following each other—in the case of the modern Marconi discharger—at perfectly regular intervals, produce a musical note in the telephone. The truly continuous wave, on the other hand, has no succession of "trains." From the moment the transmitting key is pressed to the moment when it is again raised, the uni-directional pulses delivered by the "detector" remain at a dead level. The telephone diaphragm gives one "click" when the key is pressed, and one more when it is raised, but no note is produced in between. If, however, the continuous waves are split up by some means into regular groups, then, of course, each group produces a movement of the diaphragm, and a musical note results. Thus the "breaking up" does not, as you suggest, cause each group to have only one effective wave, but enables the detector to deliver a large number of effective groups of uni-directional impulses instead of only the one produced by the pressing and raising of the transmitting key.

A. D.—*Atmospheric Troubles.*—On page 180 of the June issue of THE WIRELESS WORLD the statement is made that "signals from atmospheric discharges have no particular wave-length of their own." I have a receiving station here (Glasgow), in which I employ a tuning coil 20 in. by 5 in., containing 630 feet of wire, and find that "atmospherics" are always loudest and most numerous when I have all my inductance "in." How is this? I have a friend who has had the same experience. Also, about how far do the waves set up by an atmospheric disturbance travel? Recently the weather here has been very thundery, and one day I happened to mention to my friend (whose station is 25 miles away) that I had heard very strong "atmospherics" the night before. He replied that he had heard none at all. The prevailing conditions in Glasgow were:—rain at intervals, extremely heavy lowering clouds, no audible thunder, but very close. My friend suggests that the signals, being free and ungoverned, were impeded from reaching him by the heavy clouds. I think this is unlikely. What is your opinion?

Answer.—1. What is meant is that "atmospherics" are of all wave-lengths (though the majority are very long), and moreover are extremely highly damped; so that cutting out by tuning is impossible. The first wave of a proper train of waves produces a small effect on the receiving aerial, the second—if the receiving circuits are properly "tuned"—finds things just in the right state to be "helped on," the third adds still more to the combined effect, and so on; so that such a train has very little effect unless the circuits are so tuned as to allow this cumulative effect to take place. An atmospheric, on the other hand, produces an effect which may be compared to a violent "twang" given to a tuned string, and sets the aerial which it strikes vibrating to the aerial's own tune. Even so, however, the effect produced is greater if the aerial's own time-period is somewhere near the time-period of the one or two swings of the atmospheric, and as the majority of atmospherics are of extremely long wave-length, they are more in evidence when the circuits are tuned to long waves.

2. Hundreds—even thousands—of miles. It is held by certain writers that a large number of atmospherics received in England have their origin in the Equatorial region of South America. On the other hand, the production of local atmospherics is by no means impossible, though without further details we should not like to hold that your results are an example of this. For instance, you do not mention whether your friend got his ordinary received signals on that day at normal strength—an important point; or he may have been listening on a short wave, and thus missed the majority of X's which were going.

M. B.—The probability is that you are not in tune for the very long wave-length of the second station you mention; moreover, it has a directional aerial. We regret that we cannot answer the kind of questions you ask in paragraphs 2 and 3 of your letter. It would be contrary to etiquette to make public our own confidential information.

Correspondence.

The Reception of Signals.

To the Editor.

SIR,—It gave me great pleasure to find your answer to my letter in the first issue of THE WIRELESS WORLD.

With regard to the second portion of my previous letter, I beg to state that with the following adjustments:—A.T.J. at zero, A.T.C. at three, tuning switch on the second stop and the change-over switch on "STD. B 1." with telephones and detector across two middle terminals of tuner, the maximum strength of signals was obtained with the intensifier handle at 45°, a few degrees either side cutting out signals altogether. I have since discovered that the angle varies with the amount of A.T.C. in circuit, *i.e.*, the larger the percentage of capacity the greater the angle. Also very fine tuning, 2° or 3° being sufficient to cut one station out and bring another in, although both apparently on the same wave-length.

In fact, I often use it when "jamming" is very bad, as it is then possible to read the station required, all others being absolutely "out of it." Also the telephones used are the ordinary pattern supplied to ships, and in series with the detector. With the same adjustments, except that the change-over switch is on the "tune" side, produces no signals in the telephones whatever, no matter how close the transmitting station.

Yours, etc.,
"OPERATOR."

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Wireless in the North.

Negotiations are proceeding for the erection of a wireless telegraph station near Stonehaven. It may be recalled that in the House of Commons recently the Postmaster-General, while declining to provide underground wires to Aberdeen, suggested to provide a wireless service, so as to prevent Aberdeen being cut off from the south in time of storm. It was said that the station would be at least 12 miles south of Aberdeen, but if the field that is under negotiation is acquired it will be nearly 20 miles south of Aberdeen.

Patent Record

The following patents relating to wireless telegraphy have been applied for since we closed for press with the July issue of this magazine:

No. 13,945. June 16th. Michel de Lezinier. Rythmatic control—synchronous differentiated or syntonic by Hertzian waves from a distance, and without relays of teledynamic machines and receivers.

No. 14,034. June 17th. Valdemar Poulsen. Apparatus for closing and interrupting electric currents.

No. 14,035. June 17th. Emile Girardeau. Supplying radiotelegraphic antennae.

No. 14,927. June 28th. Wm. T. Ditcham and the Grindell Matthews' Wireless Telegraph Syndicate. Arrangement for producing electro-magnetic oscillations particularly for use in radio-telephony.

No. 15,097. June 30th. Wm. J. Lyons. Electric telegraph receiving apparatus of the selective type.

No. 15,283. July 2nd. Edward D. Carden. Method of and means for determining the electrical characteristics of high-frequency oscillation circuits.

No. 15,457. July 4th. T. Thorne Baker and Galletti's Wireless Telegraph and Telephone Company. Transmission of wireless signals.

No. 15,566. July 5th. Sterling Telephone and Electrical Co., Ltd., and Wm. Barnes Allcock. Radial selector switches.

No. 15,673. July 7th. John G. Balsillie. Wireless telegraph transmitter.

No. 15,674. July 7th. John G. Balsillie. Wireless telegraph receivers.

No. 15,696. July 8th. Geo. Horatio Jones and Leonard V. Harbor. Method for aerial signalling and intercommunicating with wireless telegraphy.

No. 15,869. July 9th. Emile Girardeau. Method of indirect excitation for oscillatory circuits.

Rubber Tiling

One of the most noteworthy features of modern enterprise is the careful attention given to detail. This is a tendency to be commended, for just as it is the little things which make up the sum of our existence, so it is the little comforts—luxuries if you will—and conveniences which ameliorate present conditions of existence. This amelioration is not confined to one class, all share in the general advancement, and, if any, it is the mass of the less fortunate of our fellow-men who have benefited in the greatest proportion. Houses, means of conveyance, amusements, and dress, all are now recognised to be subjects worthy of serious and trained thought and skilled invention. But it is of the progress in ocean travelling that we wish more particularly to make mention. Nowhere is the advancement more marked; the traveller on a modern ocean liner has no inconveniences to put up with. When he boards the vessel which is to take him across the wilderness of many waters, he no longer leaves behind him all the amenities of life ashore. Ease and comfort travel with him. He can have his smoking-room, his lounge, his tennis, his gymnasium, his swimming bath, and practically everything which he may be accustomed to on land. To give an instance of how even the minutest detail has been carefully studied, he will find, on such a steamship, for example, as the *France*, the hall lounge, the corridors, and the bath-rooms cleanly tiled, the last-named especially white and shining, with what looks like tesselated pavement. But the weight of the ordinary porcelain flooring would be too heavy for the vessel, and too noisy in the rather limited space. This flooring, however, silences the tread, and yields slightly to the pressure of the footstep. It is a unique substance, especially adapted to use on vessels, though it is literally employed all over the world, particularly in public buildings, and as a matter of fact in Buckingham Palace itself. It is known as "Silvertown Rubber Tiling," and is manufactured by the Indiarubber, Gutta-Percha, and Telegraph Works Co., Ltd. It is manufactured as tiles, in a variety of shapes and colours, which can be arranged to form any sort of pattern, while the colour can be toned to any scheme of decoration desired. The flooring on the *France* was specially designed and constructed, and the effects obtained bear witness to the splendid advance made in this particular branch of domestic comfort and hygiene.

Marconi Athletic Club

Cricket Section

Fortune has been something of a fickle jade to the Marconi cricketers this season, for success has almost invariably fallen to their opponents. Nevertheless, most of the matches were closely contested, and some very good play by many members of the elevens can be recorded.

The cricket match between the Office and Chelmsford Works at Acton, on June 21st, resulted in a good win for the Works team. Scores: Works, 98; Office, 43.

The results of other games are as follows:

June 28th, at Fulham, *v.* Fulham Palace II.: Fulham Palace, 167 for 7; Marconi's, 115.

July 5th, at Acton, *v.* Clissold: Clissold, 155 for 6; Marconi's, 125 for 7.

July 12th, at Acton, *v.* Fulham Palace II.: Fulham Palace, 116; Marconi's, 93.

On several occasions two elevens have been placed in the field.

On June 28th, at Acton, the second eleven played against the Dots C.C., and after a closely contested game the Marconi Club proved winners by 8 runs. Scores: Marconi's, 86; Dots C.C., 78.

On July 5th the same eleven played at Richmond against Fulham Wesleyans, and after an enjoyable game the Club were beaten by 18 runs. Scores: Fulham Wesleyans, 77; Marconi's, 59.

Tennis Section.

The Monthly Doubles Tournament was held on July 5th, Mr. Douet and Mr. A. E. Merritt proved the winners, and the Consolation Prize was awarded to Miss Bate and Mr. F. Noakes.

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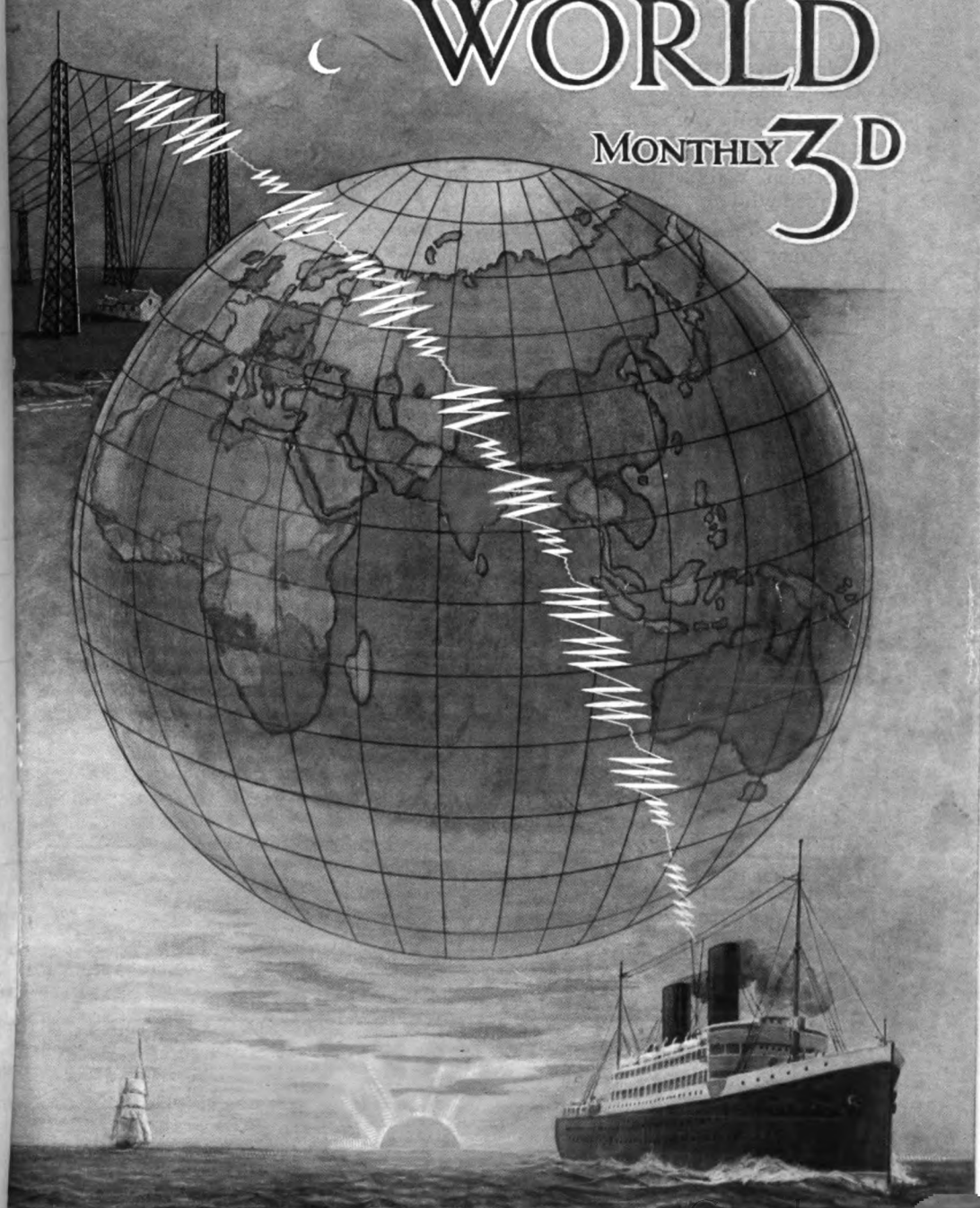
WIRELESS WORLD

MONTHLY 3D



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THE
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with which is incorporated
The MARCONIGRAPH

Vol. 1.—No. 6. (New Series) September, 1913. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

Wireless and Weather Forecasting

THE means for the advance of civilisation which Mr. Marconi has placed in the hands of science is demonstrating its value in more astonishing and definite forms every day. Even the Arctic explorer, immured behind the barrier of a thousand miles of ocean, and the winter walls that shut him in, is in communication with the outer world, and can send daily messages as to what is happening around him. A striking example of the value of this, not merely to science and commerce, but to humanity, is furnished by the work of Dr. Mawson in Polar regions. The Australian Government Meteorologist (Mr. Hunt), since March 24th, has been in constant touch with Dr. Mawson, hibernating in Adelie Land, and has received *via* Macquarie Island a series of messages of great interest to those devoted to the science of the weather. Mr. Hunt indicates that the length of time during which such messages have as yet been received is insufficient to form the basis of any final assertion as to the actual effect of weather in the Antarctic upon weather in Australia. Everyone knows that the result of scientific observation in the far southern regions has established the weather connection between Australia and the land surrounding the Pole; but the details of the natural processes generating there, and operating in the Commonwealth in the shape of storms and cyclonic visitations, cannot be ascertained so far in a way useful to the weather prophet. We are, however, rapidly passing from the region of surmise and theorising into the realm of ascertained fact. It only needs an extension of the system of wireless telegraphy, with appropriate recording stations along the Antarctic continent to the west of Adelie Land, and thence to such a strategic centre as, say, the Kerguelen Group, which in turn might be linked up with the Leeuwin, to establish a system of communication of immense value to meteorological science in southern regions. Forecasting weather is a strictly limited business to-day, but the knowledge of the part played by the Antarctic region in the manufacture of Australian weather conditions has been sensibly advanced by the wireless messages from Dr. Mawson. The value of wireless telegraphy as an aid to meteorology may not be immediately obvious to the average man; but the sceptic should remember that there is a side to all scientific investigations that makes its appeal to the few long before it justifies itself in the region of practical life, and this matter of wireless telegraphy in its usefulness to meteorology will undoubtedly be appreciated by the many when it becomes expressed in terms of commercial advantage.

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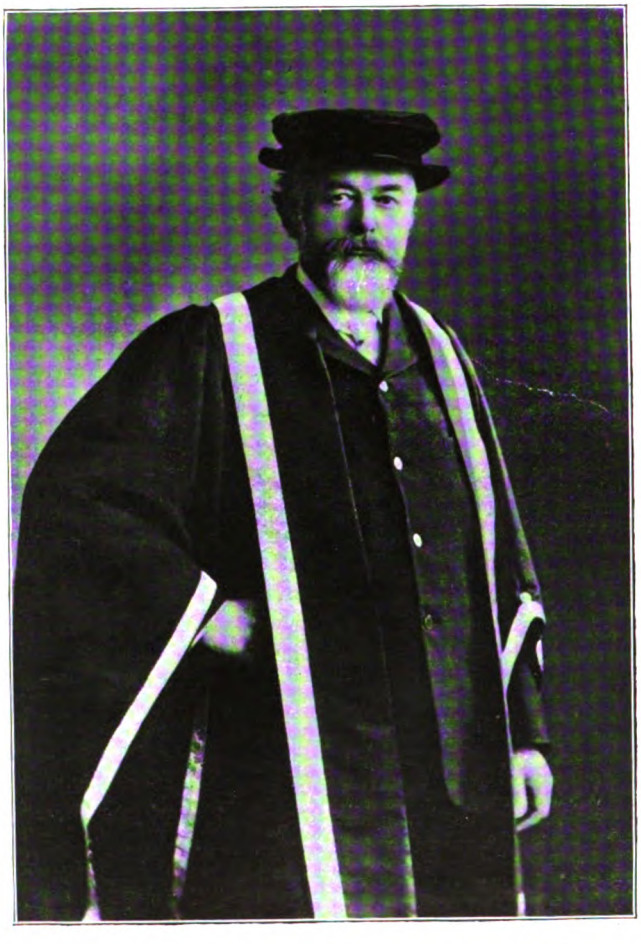

SIR OLIVER JOSEPH LODGE.

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Personalities in the Wireless World

SIR OLIVER JOSEPH LODGE

Principal of Birmingham University and President of the British Association for the Advancement of Science

. . . " He was a scholar, and a ripe and good one,
Exceeding wise, fair-spoken and persuading. . . ."

THE adaptation of this quotation to the subject of this month's biography needs no apology. The words in which Shakespeare speaks of Cardinal Wolsey could aptly be applied to Sir Oliver Lodge, and, if it be allowed to alter a quotation to fit an altered subject, we might add :

" Witness for him
That place of learning which he raised in you,
Birmingham, . . . though unfinished, yet so famous,
So excellent in art, and still so rising,
That Englishmen shall ever speak his virtue."

Sir Oliver Lodge has been Principal of the new University of Birmingham since its inauguration in 1900, and it is largely due to his zeal and influence that it has achieved already so important a position in the educational world.

Sir Oliver was born at Penkhall, Staffordshire, on June 12th, 1851. He was educated at Newport (and Salop) Grammar School, and was intended for a business career. But science held too great an attraction for the young student, and, instead of following the course prescribed for him, he entered University College, London, in 1872, and five years later gained his doctorate of science. Later, he was for many years Reader in Natural Philosophy at the Bedford College for Women, until he was appointed Professor of Physics in University College, Liverpool, which post he only vacated to take up work at Birmingham. In 1891 he presided over the Mathematical and Physical Section of the British Association, and this year he is President of the same Association for the Session which opens this month at Birmingham University. In 1902 he was knighted, and if there was anyone connected with science who deserved recognition, it was Dr. Lodge. He had already made a name for himself by reason of his scientific research, which included investigations on lightning, the seat of the electro-motive force in the voltaic cell, phenomena of electrolysis, and the speed of ion, the motion of the ether near the earth, and electro-magnetic waves and wireless telegraphy. His treatises on these various subjects are many, but the one perhaps most likely to interest readers of THE WIRELESS WORLD is that which was published in 1908, entitled " Signalling Across Space Without Wires," and another, " The Ether of Space." But Sir Oliver Lodge has not confined himself to this or even kindred branches of natural science. Metaphysics and philosophy have engaged his attention to a considerable extent, and his works dealing with such matters are widely appreciated by a large and ever-increasing public. His authorship in this direction is too extensive to allow for them to be treated individually, but mention must be made of " Life and Matter," a book which has gone into several editions since it was published in 1900, and which is a masterly exposition of the philosophy that he holds so dearly. Besides this, he has written short articles on, or introductions to, books of quite a different nature, notably Ruskin's " Unto This Last," and " Sesame and Lilies," which have recently appeared in the " Everyman's Library." But most interesting of all, perhaps, is his " Biography of John Priestley," another of Birmingham's famous men, for this great forerunner of modern thought bears a striking resemblance to his biographer, both in his outlook on life and his qualities as scientist and philosopher. Therefore, in conclusion, let us transpose a passage which Sir Oliver Lodge uses in connection with Priestley, and apply it to the subject of our sketch : " His services to experimental science are astonishing, but his constant dignified pleading for civil and religious liberty are of even more value."

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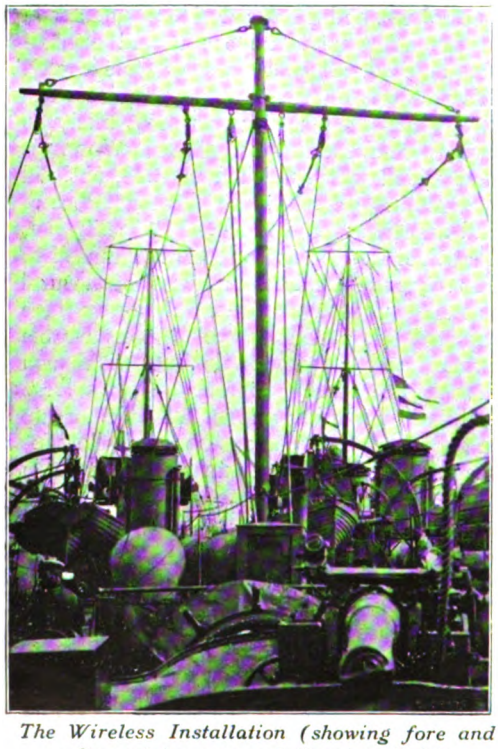
Ships at War

Incidents in and Observations on the Recent Naval Manœuvres.

ONE of the great events in the naval year has been brought to a close by the completion of the manœuvres on the East Anglian coast. What exactly has taken place will not be known until Sir William May issues his report, but the main events have been sufficiently prominent to



The Wireless Installation (showing fore and aft masts) on one of Great Britain's latest Dreadnoughts.

engage the attention of the public. The vessels engaged in the manœuvres numbered some 350, and they were divided into the "Red" and "Blue" fleets. The "Red" were the invading force, the "Blue" the defending. Perhaps the most exciting episode of all was the landing of 4,000 troops by the "Red" fleet at Grimsby, when the Humber was captured, together with two important positions, Grimsby and Hull, with the adjoining wireless stations at Cleethorpes and Humberstone. These were looked upon as great prizes by the victors, for as soon as they came into possession of them they started communicating with the fleet outside and availed themselves to the full of their good fortune.

That was on the Thursday, July 24th. Later, another invasion was made by the "Red" fleet, on Sunderland and Blyth. The tactics employed were much the same as in the case of the earlier victories. On Saturday morning a strong "Red" force appeared off the Tyne. About 4.30 a.m. a division of the "Red" fleet, consisting of about twenty vessels, approached. They were challenged by the "Blue" cruisers and a number of torpedo boats which had left the harbour immediately after the "Red" vessels had been sighted, and after heavy firing the attacking vessels were forced to retire. This, however, appears only to have been a feint on the part of the "Red" fleet in order to prevent assistance being sent to other ports, for early the same morning the "Red" fleet landed a force at the important Northumberland coaling port of Blyth, and captured the town. Two sighters, seven destroyers, and two transports rapidly approached the harbour. The coastguard on the look-out immediately gave the alarm, and telephonic communication was effected with the Northern Cyclists Battalion, who were encamped a little to the south of the town. A party with two maxims immediately hastened to their defence, but they were too late for the "Red" transports. The *Rohilla* and the *Rewa* had anchored, and had already landed a force under the cruisers' fire. The cyclist corps could offer but a feeble opposition to the attackers, who were brought ashore in steam pinnaces, each drawing a string of six boats, and the defenders were ultimately driven back and their machine guns captured. Meanwhile, a destroyer and submarine, which had been cruising along the coast, fell into the enemy's hands, but not before the submarine had put one of the "Red" trans-

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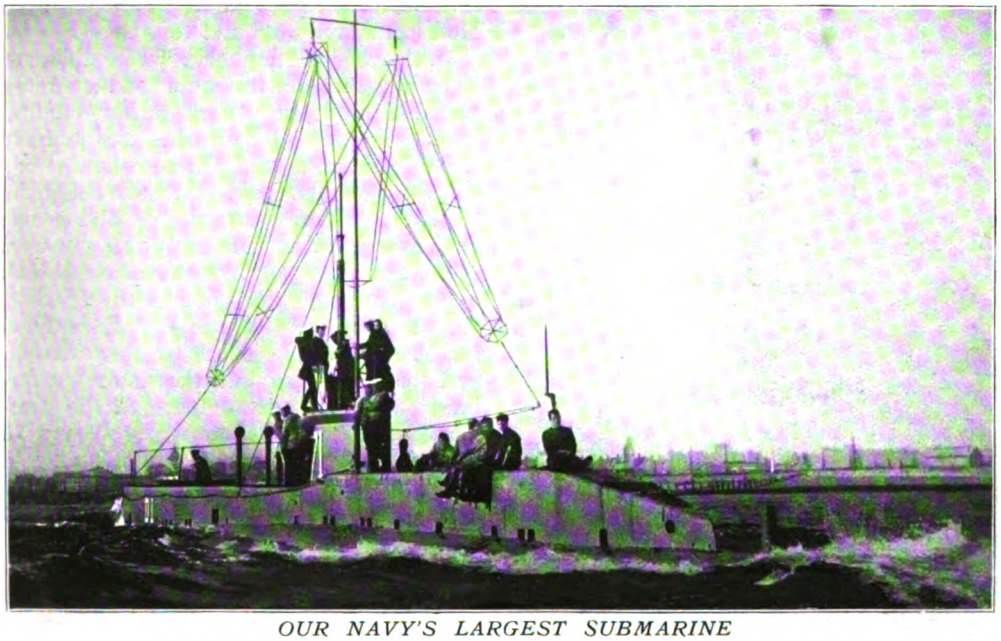
ports out of action. This, however, availed little in defending the city, for the port was now completely at the mercy of the invading army. The General Post Office, the railway station, and other places were "destroyed." The bridge over the South road was blown up to prevent the arrival of a relieving force from Tynemouth, the telephone and telegraph wires were cut, and the lighthouse was occupied and frequent signals exchanged with the ships outside. Much the same happened at Sunderland. The town was captured and its principal buildings destroyed, here a surprise awaited them: fourteen vessels of the "Blue" fleet had arrived off the port, and formed a ring round the entrance. There was no fighting. The "Reds" could only accept capture at the hands of the enemy.

Such are the outward and visible signs of "manœuvres" as far as the general public is concerned. What they mean to the actual participants is an entirely different thing. Manœuvre days are days of extreme stress and hard work, with very little compensation in the way of excitement. No man, except



OUR NAVY'S LARGEST SUBMARINE

and one of the first to be fitted with Wireless, an asset which has been found of enormous value in the recent manœuvres.

but here disaster followed swiftly on the heels of success. While the "Red" troops were landing four torpedo boats of the defending force arrived. The "Red" destroyers drew out to meet them, and the "Blue" ships thereupon withdrew—all but one submarine, which had meanwhile drawn near. Hiding behind a small merchant steamer, it approached the cruiser unperceived, and fired a torpedo, effectively disabling the "Red" cruiser. While this was in progress, the invading troops had reembarked in the transports, and the "Red" fleet prepared to leave the harbour. But the admirals or their staff officers, knows what is happening. The rest of the officers and men have a general idea that one side is to attempt to land troops, and that the other side is to prevent them doing so, but apart from that there is little except extra labour to distinguish manœuvre practice from any other day's work. Sea routine goes on as usual: scrub decks, breakfast, divisions, prayers, the work of the ship, stand easy, more work, till working hours are over. The captain divides his time between his cabin and the bridge; the commander is intensely occupied from early morning till late at night

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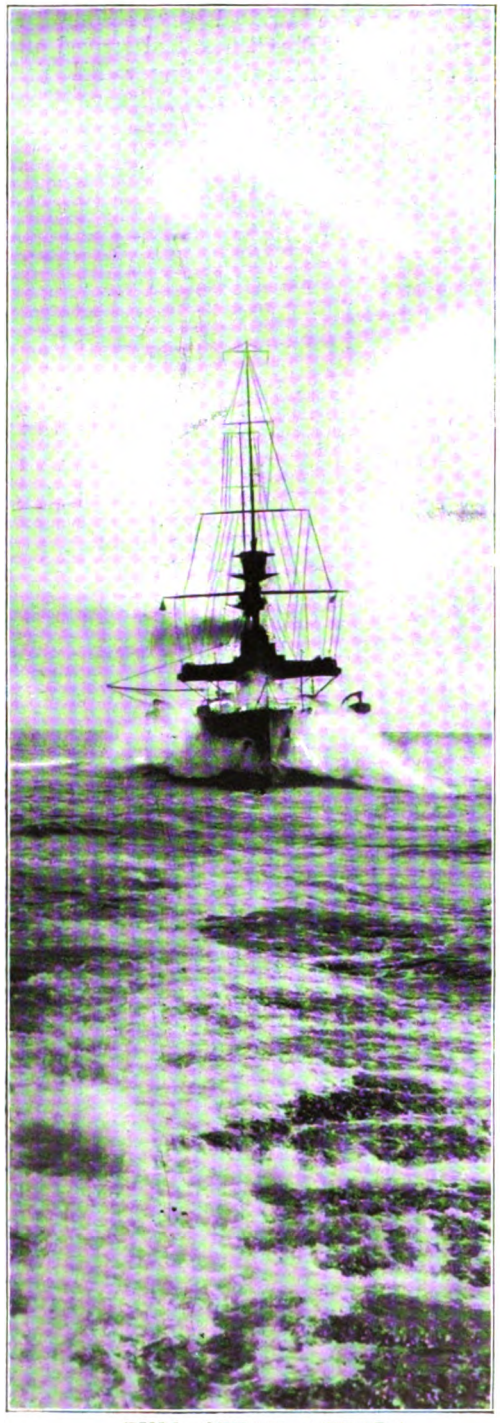

FULL STEAM AHEAD!
A Leviathan ploughing its way through the waters.

with the ordering and supervision of the whole work of the ship; the first lieutenant, usually gunnery lieutenant as well, is responsible for the condition of the decks—acres of decks down below. The torpedo lieutenant is in charge of the torpedoes and all connected therewith, and all electrical appliances generally. The watch-keeping lieutenants relieve one another upon the bridge and the upper deck. Upon the navigating officer falls the responsibility of keeping the ship upon her course. He is not supposed to require any sleep. He can sleep if he likes, but his responsibility continues. So long as the ship is at sea so long is he on duty. He becomes red-eyed and very silent.

In the good old days things were different. Then naval manœuvres were conducted in a placid happy spirit. The attacking admiral used to spy for a hole in the rules and sail through them, as the phrase went. They sailed to pleasant places and made delightful landfalls. There was no hurry, and people went ashore and saw life, and so on. It used to be a fine thing to finish up a long cruise with a big fleet action, two long lines of battle, the slow ships in the rearguard huddled together in a vain effort to keep station, and the guns firing, and the smoke turning into a blue and yellow fog, and the commander pressing buttons in a frenzy of excitement in the conning tower, trying to fire a torpedo, while the admirals on either side exchanged signals, which gradually indicated a rising temperature. Then they would stop, the two fleets would join up amicably, and steam in a most tremendous and imposing majesty into Arosa Bay, or Lagos, or somewhere, and all would be peace. But that is all over now. Things have become extremely scientific and there is no slacking and no practice. All is in deadly earnest, and life on a destroyer at such times is a hard one. The captain hardly ever leaves the bridge by day or night. He may snatch a few minutes on a hard couch in the chart house if he is lucky, but three or four nights in the dirty weather and fog in the great North Sea is usually his portion. Then for the men. The work must be done somehow, and under the worst conditions. No service clothes on for such times as this. A sweater, an old pair of breeches, sea boots and oilskins are good enough to be yanked out in such rough work. As for meals, it is

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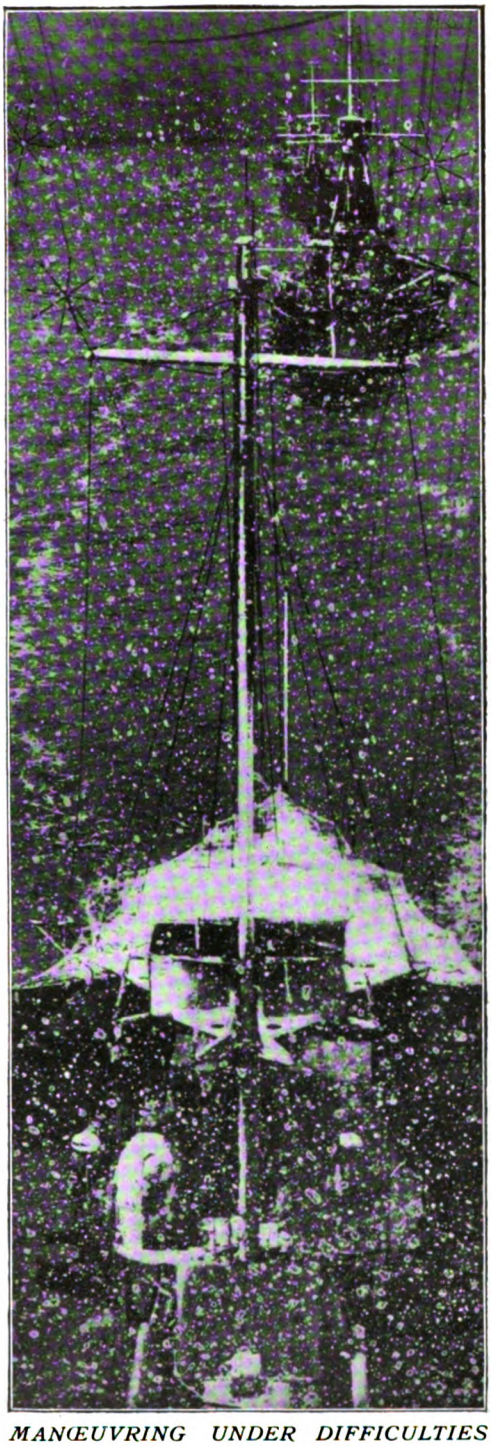
often impossible to sit down. Sardines and whisky are consumed standing.

Life on a submarine is not much easier. "The submarine goes grinding along with a noise like a mill, her long fish-body awash, the helmsman and the captain aloft, on the circular turret amidships, peering over the canvas screen. Down below the artificers squat in the steel tube among the furious petrol engines, in the midst of a stupefying racket enough to drive them insane. If the boat is to sink, there is a sudden silence as the engines stop and the electric motors are switched on. The figures vanish from the conning-tower, and presently there is nothing to be seen but the slender pole of the periscope, cutting the waves like the wing of a bird. The captain, below, grasps the steel handles, shoulder high, which swing the mirror, and staring into it beholds a tiny picture of the great field of sea and the scattered ships, like little toys. If he sink deeper, submerging the periscope, the mirror reflects a cliff of green water. In the captain's brain is an accurate record of exactly how much weight is in each part of the vessel, and a precise estimate of the orders he must give minute by minute. Upon the absolute integrity of the response of his mind depends the existence of all on board."

Meanwhile, on the surface, the battleships follow in the wake of one another, the ship ahead lifting and falling with the rhythm of the waves. At night the speed lights shine from the yards, unless the Admiral orders all lights to be extinguished, as he usually does in manœuvres. Then the officer of the watch, keeping station, is oppressed with care. If a fog descends he can see nothing but the fog-buoy trailing astern from the ship ahead, and dimly squaltering through the hissing water like a duck.

Again, there is the danger of a torpedo attack. The destroyers prefer a moonless night with a little sea-way and a dash of rain. Hour by hour the guns' crews in battleship and cruiser stand by their guns, staring into the gloom. A red cinder flying from her funnel may betray the destroyer, and the quick-firing guns open instantly. But the target is travelling at thirty miles an hour. Day and night, in the wireless room, a blue-jacket dwells in an atmosphere like the heart of a thunderstorm, blue flames playing about him and a crackling noise of sparks.



MANŒUVRING UNDER DIFFICULTIES
It is not always fair weather sailing. This photograph was taken from the Captain's bridge during a snowstorm.

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The admiral or captain receives the messages written out on signal forms, and acts upon them as he may. Ten years ago there was no wireless; a ship desiring to convey information to another must come within sight of her and signal with flags.

During the present manœuvres wireless has been used more extensively than on any previous occasion. At times so many code messages have been passing simultaneously that a certain amount of interference might have seemed almost inevitable and the smart and rapid working, and freedom, in the main, from interruption, has been a noteworthy feature. The fact is, naval wireless operating has reached a very high state of excellence. All important work is being done by cypher automatically changed with every message sent, and this, combined with the great increase in power and range of ships and stations, makes it almost impossible for outsiders to identify the sources of messages or those to whom they are sent.

And this mention of wireless calls for particular remark. Its importance in time of war cannot be overrated, and this not only in connection with battleships, but with vessels of the merchant service, all of which, be it remembered, would be likely to be affected in the event of a naval war. Perhaps the best means of illustrating this point is to quote from a report issued not very long ago by the Board of Admiralty on the subject of Naval Warfare, and the possible invasion of England:—

"The really serious danger that this country has to guard against in war is not invasion, but interruption of our trade and destruction of our merchant shipping. The main object aimed at by our fleet, whether for the defence of commerce or for any other purpose, is to prevent any ship of the enemy from getting to sea far enough to do any mischief before she is brought to action . . . if a fleet of transports is sighted anywhere by a single cruiser, or even by a merchant ship if she is fitted with wireless, every ship which happened to be in a position to intercept the transports would at once get the order to concentrate as necessary for the purpose, whether she was at sea or in harbour . . even supposing that by some extraordinary lucky chance the transports were able to reach our coasts . . . long before half the troops could be landed, the transports would be attacked and sunk by submarines . . . besides the submarines there would always be a large force of destroyers . . . a superior force would be brought to attack him before the landing could be completed . . . an invasion on even the moderate scale of 70,000 men is practically impossible."

"PARASITIC WAVES"

M. FRANK DUROQUIER is a French Meteorologist of repute, and his observations are always deserving of attention. His most recent investigations have resulted in his establishing the fact that the telephone receiver is remarkably sensitive to climatic conditions, so much so that an intelligent wireless operator can foretell the weather from the character of the noises in his receiver.

The noises to be heard in a receiver he attributes to the "parasitic waves" of the atmosphere which are set in motion by each change in the weather. Hitherto it has been believed that the wireless system could only foretell storms, by means of a very clever, if complicated, arrangement which causes the greater disturbances to register themselves automatically through the medium of a pendulum. But the use of the telephone makes it possible to obtain the same results in a much less roundabout way.

"By these means," says the professor, "we have studied the parasitic waves of the atmosphere for a whole year, and we were not only surprised at the great variety of these parasites, but at the accuracy with which they register the character of atmospheric disturbances." Connect a telephone receiver with a wireless system and you can tell from the character of the noises whether a gale, or a thunderstorm, or cold, or rain is coming.

A strong crackling signals the approach of a thunderstorm. A fall of hail causes a slight whistling in the receiver. Asthmatic, irregular noises betoken a coming fall in temperature and frost. If the wave-lengths of the parasites shorten and give the impression that the noises are grouping together, you may safely predict a change in the wind. Great barometric depressions and very violent storms are heralded by very frequent cracklings, which now and again almost develop into a sound as of an explosion.

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The Transmission of Photographs and Drawings by Wireless Telegraphy

By PROFESSOR KORN

Professor Arthur Korn, of Charlottenburg, is the inventor of the process which he explains in the following article.

THE telegraphic transmission of photographs and drawings by means of conductors is no longer a dream; thousands of photographs have been exchanged telegraphically between Paris and London, Berlin and Paris, Monte Carlo and other photo-telegraph stations; and as the publication of pictures in large illustrated papers has thus become possible, with a considerable advantage over the ordinary transmission by post, it may be said that photo-telegraphy has fought its way into practice. The illustrations in Figs. 1 to 3 will enable one to form an opinion of the transmissions that have hitherto taken place.

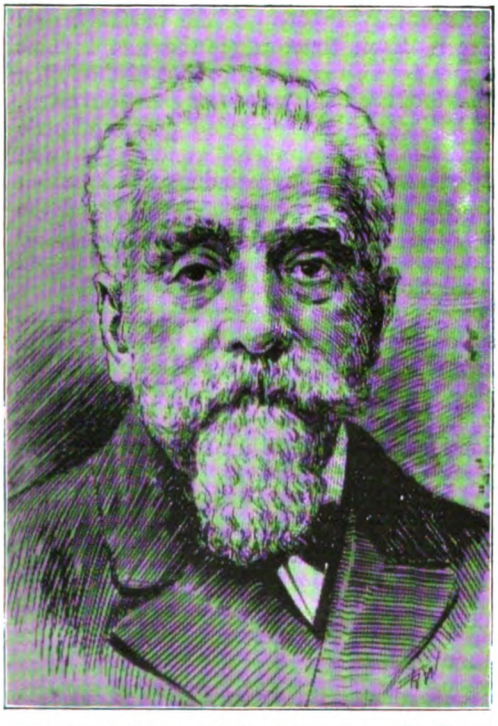

Fig. 1.—A Telegraph Transmission of a Drawing by means of an Artificial Conductor.
The portrait is that of Senator Villa, President of the International Exhibition, Turin, 1911.

Apart from the problem of the tele-vision, which, being based upon the same principle as photo-telegraphy, is possible in itself, but can only be carried out by means of enormous sums of money, we are also attracted to the task of transmitting photos and drawings by "wireless."

Would it not be most interesting on board an ocean liner if, besides the Marconigrams which maintain communication with the other parts of the globe by means of words, we were to find also in the "ocean journals" pictures of the most recent events? But not only for the sake of amusement, but for a great number of important applications, the wireless transmission of photographs and drawings will meet with great interest; we mention here as an example only the possibility of transmitting signatures absolutely reliably from ocean liners to home; the possibility of transmitting the portraits of criminals, who are trying to escape on an ocean liner, by "wireless" to the big steamers at sea, and thus of identifying the malefactors with more certainty than is possible through the mere description in words.

There has never been a lack of proposals and primitive tests in this respect, and I refer those readers who are interested in the completest possible specification of these

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Fig. 2.— A Telegraphic Transmission of a Photograph by means of an Artificial Conductor.

Colonel Mangin, who was chief of the French Troops fighting in Morocco.

tests and proposals to the summary in Korn-Glatzel's "Handbuch der Photo-telegraphie and Telautographie" (published by Nemnich, Leipzig, 1911), pp. 159–163 and 410–413.

I would like to explain here briefly the principles of the method, which is based upon my picture telegraph methods (with the use of conductors), and the possibility of application of which I have already proved through the tests I carried out in conjunction with Professor Glatzel.

Just as with picture-telegraphy with conductors, we can distinguish between a black and white method (telautography) and a half-tone method. Whilst, with the methods of the second kind, the qualities of selenium are made use of with advantage in the sending station, because its electric resistance alters under the influence of light, one uses for the black-and-white method an arrangement in the sending station whereby the black-and-white picture (handwriting, drawing, autotype) to be transmitted is engraved by means of a non-conducting material on a metal foil, which is wound round a rotary cylinder 4 (Fig. 4). A metal point is sliding on the foil and moves just like the stylo of a phonograph with every revolution of the cylinder a little sideways, thus engraving the picture in fine spiral lines. Each time, when the metal point comes across a conducting spot of the foil, a part 5 of the inductance 3 is short-circuited, which regulates the period of the electric oscillations of a wireless "sending" station in connection with the inductance 1 (which is coupled with the inductance 3) and the capacity 2. The station is supposed to transmit with non-damped or feebly damped oscillations, which are, according to what has been said before, tuned to a certain period, so long as the part 5 of the inductance 3 is not short-circuited; but if this part is short-circuited, *i.e.*, if the metal point of the telautographic sender comes across a conducting spot of the picture foil, the oscillation is put out of tune.

The receiver is provided with an aperiodic circuit II, which consists of a capacity 8, an inductance 7, and a detector 9 (a thermo-detector is best); the inductance 7 is coupled with the inductance 6, which is inserted between antenna and earth. A large inductance 10 and a string galvanometer 11, which we shall consider presently, are connected in parallel with the condenser 8. The inductance 10 serves the purpose of keeping the arriving currents, which alter their direction, off the galvanometer 11, and of letting only currents of one certain direction pass through same, so that it can deflect only to one side. If the receiver is

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properly tuned to the incoming waves of the sender the string galvanometer will each time deflect when the metal point of the transmitter is on a non-conducting spot of the picture foil, whilst no deflection will be observed when the metal point in the sender is on a conducting spot of the foil.

The deflections of the string galvanometer are then used in the same manner as with ordinary picture telegraph receivers (with conductors), to reproduce in the receiver the picture in question. The string galvanometer consists of a fine metal thread (14, Fig. 6), which is stretched between the poles of a strong electro-magnet, and through which the currents are led to cause the deflection of the galvanometer. The thread is deflected when an electric current passes through it, as a consequence of the effects of the electro-magnet, in the plane vertically to the magnetic lines of force, and in one or the other direction, according to the direction of the current that passes through. We want to reproduce the picture in the receiver on a sensitive film, wound round the receiving cylinder 16. This receiving cylinder rotates in a box, into which no light can penetrate, synchronously with the transmitting cylinder (on which the foil with the original picture is laid), a thread on the axis ensuring that the cylinder is moved with every revolution a little sideways in the direction of its axis, exactly as the metal point in the sending apparatus is moved with every revolution. We concentrate the light of a Nernst lamp 15, by means of a lens, on the thread 14, and project, by means of a second lens, an image of the thread on the slit of a tube leading to the receiver-box. The optical device is so arranged that the shadow of the thread just covers the slit when the thread is not deflected; in this case, no light enters the receiver-box; when, however, the galvanometer is traversed by a current, *i.e.*, when the thread is deflected, the shadow of this moves away from the slit, and light penetrates into the box; the light rays are collected by a lens in the tube and projected on to a small element of the receiving film, so that every non-conducting spot of the picture foil in the sending station corresponds to a photographic impression on the

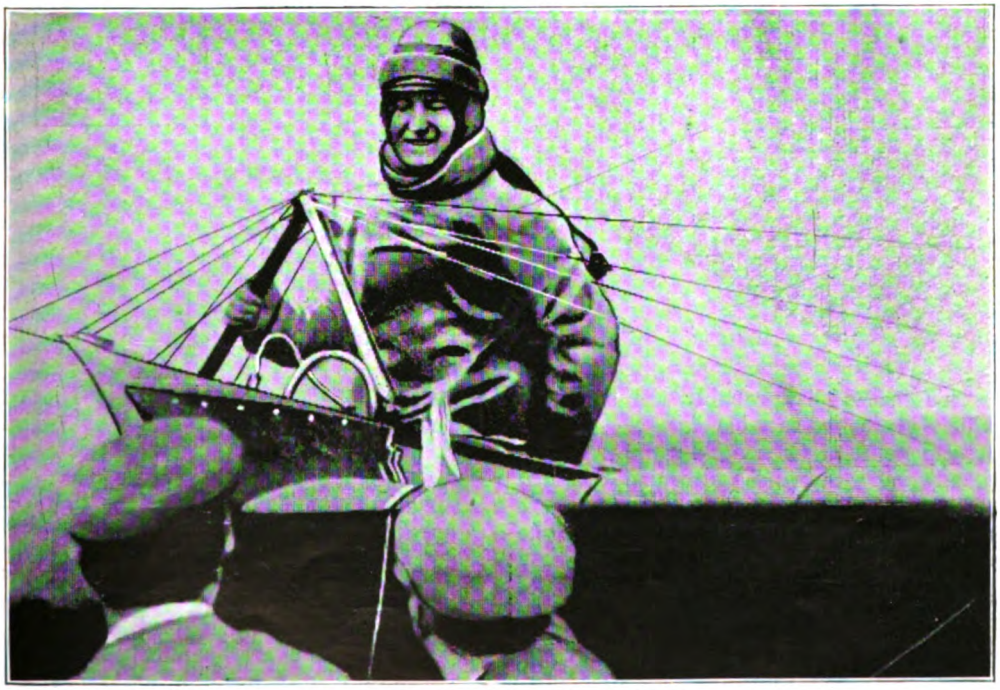

Fig. 3.—M. Brindejonc de Moulinais.

This photograph was transmitted from Berlin to Paris by Wireless Telegraphy. The distance covered was about 750 miles.

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receiving film; however, each time the metal point of the transmitter rests on a conducting spot of the foil no photographic impression will be obtained on the receiving film. If the movements in the sending and receiving station are synchronous the picture will be registered photographically, line by line, on the receiving film. The synchronisation of the movements in the transmitter and receiver will not cause great difficulties, as with wireless transmission the speed of the two rotating cylinders must be considerably lower than with the transmission over conductors.

receiver is actuated for every corresponding shade, and in accordance with the relay, which is actuated in the receiver, the galvanometer (of the form shown in Fig. 5) indicates a greater or smaller deflection. Such a string galvanometer as I am using for the half-tone transmissions with selenium in the receiver consists of two metal threads stretched between the poles of a strong electro-magnet; a tiny leaf of aluminium is fixed in the centre of the two threads. The light of the Nernst lamp 15 is concentrated, by means of a lens, on the leaf, and an enlarged image of the latter is then projected,

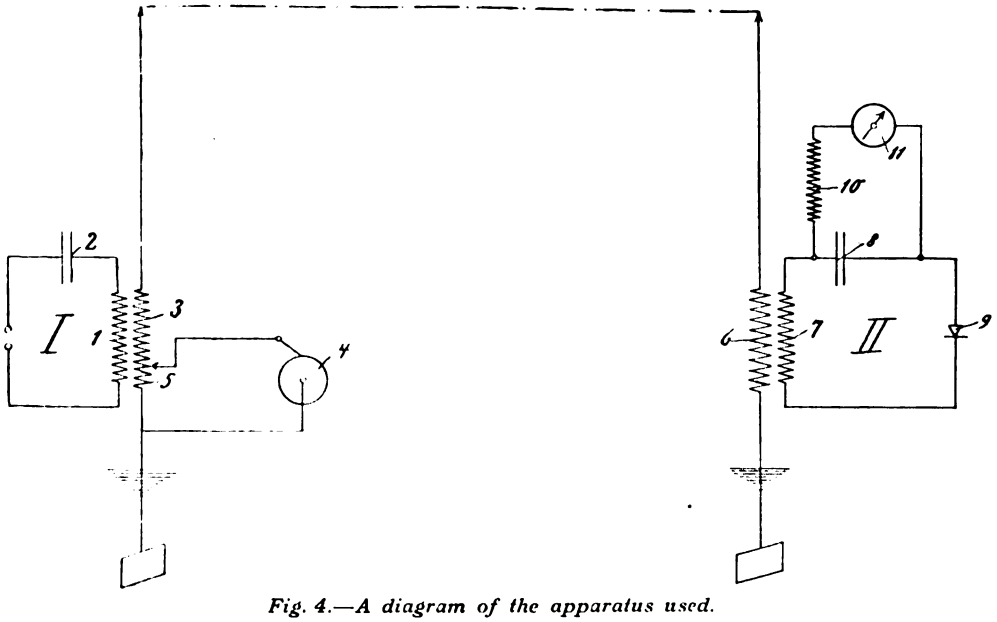

Fig. 4.—A diagram of the apparatus used.

This method is probably the only one which is really suitable for the wireless transmission of black-and-white pictures (handwriting, drawings, autotypes); if real half-tone pictures are to be transmitted it is best to make use in the transmitter of the sensitiveness to light of selenium; it is then possible to distinguish a *definite* number of shades (perhaps 10–20) in the original photograph, by measuring the degree of every part of the original photograph by means of a selenium cell, and by emitting from the sender a wave of a certain period for every shade. A certain relay in the

by means of a second lens, on an opening of the tube leading to the receiver-box. When there is no current passing through the galvanometer the shadow of the leaf just covers the opening; when, however, a stronger or weaker current is sent through the galvanometer, the shadow of the leaf moves more or less away from the opening, so that more or less light is thrown on the receiving film, according to the quantity of the currents that passes through the galvanometer, *i.e.*, according to the shade of the part that is just being transmitted of the original photograph. Thus, assuming syn-

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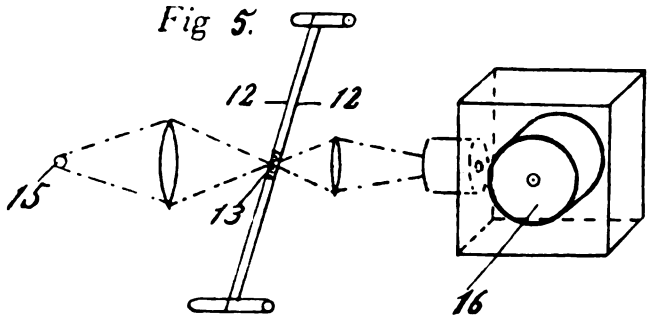
chronous movements of the sending and receiving cylinder, the picture will be reproduced on the receiving film like a proper half-tone photograph.

The half-tone method presents no special difficulties; the essential problem is to keep the times for the transmission as short as possible to enable a practical utilisation of the method.

Fig 5.



WIRELESS AND LIGHTSHIPS

THE project of establishing a wireless telegraph installation on board the Kish Lightship in Dublin Bay was discussed at a recent meeting of the Dublin Port and Docks Board. Although it is not the first time that the Board have considered the question, the latest meeting does not appear to have brought it appreciably nearer a solution.

The need for the establishment of a wireless telegraph installation on board the lightship arises primarily from the necessity of obtaining advice regarding the arrival of vessels in the harbour. At present there is no means of ascertaining the arrival of a vessel at the quays until she is seen coming up the river. If a vessel is late no one can tell how long overdue she is likely to be, and the owner's representative must waste considerable time in waiting her arrival. The disadvantage of the lack of communication with the Kish Lightship is particularly noticeable in the case of foreign vessels requiring tugs. If such a vessel wants a tug she must lie-to in the bay until she "catches the eye" of some chance coast-guard, who rushes to the nearest public call office and communicates the news. Another method adopted is for the pilot boat, which may be anywhere in the bay, to steam slowly into Kingstown and send a man ashore to telephone the authorities in Dublin.

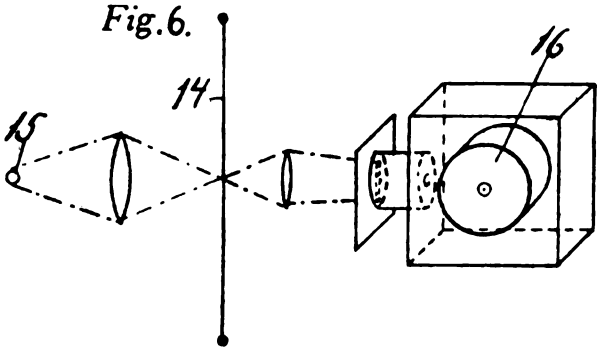
These methods do not commend themselves to the commercial people of Dublin, and it is not surprising, therefore, that a representative body such as the Port and Docks Board should be intent upon securing the effective and more economical means of communication which a wireless installation on board the Kish Lightship would afford.

The Port and Docks Board brought their suggestion some time ago before the Irish Lights Commissioners, who have sole control of the lightship.

It is understood that the Port and Docks Board are anxious to have this project carried out for the benefit of the commercial people and the shipping companies of Dublin, who feel the need for some means of communication with a ship placed as the Kish Lightship is, which could give notification of ships coming from Liverpool and cross-Channel ports, and which, perhaps, would be of still greater service to foreign vessels which, naturally, cannot always be up to time.

The lightship is in an admirable position for the purpose for which the Board want to put it. It is in the fairway of ships coming into Dublin and Kingstown, covering the Kish Bank, which is said to be one of the most dangerous in the United Kingdom.

Fig.6.



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Suitable Wire Dimensions for High Frequency Resistance*

By L. W. AUSTIN

WITH high frequency experiments it is often necessary to introduce some resistance into the oscillatory circuits. For the sake of convenience in calculating it is desirable to measure the wires for the resistance, so that the so-called skin effect may be neglected; thus, in this way, the resistances can be measured after the continuous current methods with the certainty that the high frequency resistance will practically be of the same value. If the experimenter does not take the trouble to calculate the ratio between the high frequency and alternating current resistance, he will often use wires of too small dimensions.

I have, therefore, calculated graphically in accordance with Prof. Zenneck's observations † the diameters of the wires which can be used for various wave-lengths, without the above-mentioned difference of resistance exceeding one per cent. By doubling the diameter as stated in the table this difference amounts to about 10 per cent., whilst a decrease to one-half reduces the difference to about one-tenth per cent. (Zenneck).

"Maximum Current" in the third column means a current which can be conducted by the various strengths of the Constantan wires without producing too much heat; the current capacity of Manganin is almost the same. Carbon and various electrolytes can of course be used instead of the metals with even smaller corrections, but their resistance temperature co-efficients are so great that these substances are not so suitable as resistances as are Constantan or Manganin.

If a greater current capacity is desired, the wires can be used in parallel connection, soldered between parallel metal bands, as long as the intermediate space is not too small.

TABLE OF WIRES, FOR WHICH THE HIGH FREQUENCY RESISTANCE IS GREATER THAN THE CONTINUOUS CURRENT RESISTANCE BY LESS THAN 1 PER CENT.

Wave-length m. (ft.)	Constantan or "Advance Wire."		Manganin Diameter m/m (in.)	Platinum Diameter m/m (in.)	Copper Diameter m/m (in.)
	Diameter m/m (in.)	Maximum Current Amp.			
100 (328)	0·30 (0·0118)	3·5	0·29 (0·0114)	0·13 (0·005125)	0·006 (0·000236)
200 (658)	0·46 (0·0181)	4·5	0·40 (0·01575)	0·20 (0·00788)	0·045 (0·00177)
300 (986)	0·57 (0·0224)	5·5	0·50 (0·0197)	0·27 (0·0106)	0·09 (0·00354)
400 (1314)	0·66 (0·0259)	7·0	0·60 (0·0236)	0·30 (0·0118)	0·10 (0·00394)
600 (1972)	0·83 (0·0327)	8·0	0·75 (0·0295)	0·37 (0·0145)	0·15 (0·00592)
800 (2630)	0·98 (0·0386)	10·0	0·88 (0·0346)	0·42 (0·0165)	0·20 (0·00788)
1,000 (3288)	1·10 (0·0433)	11·5	0·99 (0·0389)	0·50 (0·0197)	0·21 (0·00827)
1,200 (2946)	1·20 (0·0472)	12·5	1·10 (0·0433)	0·57 (0·0224)	0·22 (0·00866)
1,500 (4932)	1·30 (0·0512)	14·0	1·21 (0·0477)	0·63 (0·0248)	0·26 (0·01022)
2,000 (6576)	1·52 (0·0599)	17·0	1·38 (0·0544)	0·73 (0·0287)	0·30 (0·0118)
3,000 (9864)	1·80 (0·0709)	24·0	1·62 (0·0639)	0·80 (0·0315)	0·33 (0·013)

German silver ranks approximately with Manganin.

* (From the *Jahrbuch der Drahtlosen Telegraphie und Telephonie*). † *Leitfaden der drahtlosen Telegraphie*, p. 352.

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THE IMPERIAL WIRELESS SCHEME

THE MARCONI AGREEMENT WITH THE BRITISH GOVERNMENT FOR THE ERECTION OF A CHAIN OF WIRELESS TELEGRAPH STATIONS WAS RATIFIED BY PARLIAMENT ON AUGUST 8TH.

THE new Marconi contract was debated in the House of Commons on Friday, August 8th. The Government motion for the ratification of the agreement, which stood in the name of Mr. C. F. G. Masterman, the Financial Secretary to the Treasury, read as follows:

> "That the agreement between Marconi's Wireless Telegraph Co., Ltd., Commendatore Guglielmo Marconi, and the Postmaster-General, with regard to the establishment of a chain of Imperial wireless stations (Parliamentary paper No. 217 of session 1913) be approved."

In his explanatory statement, Mr. Masterman remarked that in the original contract which came before himself and the Treasury a year ago last March, they were convinced by the representations made to them that there was only one company in a position to guarantee long-distance wireless work. After the lapse of a year and a half they were not convinced that any other company was qualified. The Treasury, he said, had a clear and satisfied mind as to the value of the contract.

Mr. Masterman was followed by Sir Henry Norman, who declared at the outset that his own attitude was simply that of an advocate for State ownership of the wireless stations. He disclaimed any prejudice against the Marconi Company, and said that he had never in speech or in writing spoken of Mr. Marconi's work without high appreciation and of himself otherwise than with perfect courtesy and respect. "I know perfectly well," he said, "that in the commercial organisations of wireless telegraphy to-day the Marconi Company is ahead of all its rivals." Sir Henry Norman suggested that the Government should adopt and work their own scheme of wireless telegraphy. In this attitude he was supported by Sir Croydon Marks, whose speech in opposition to the ratification of the contract followed upon similar lines to that of the previous speaker.

Lord Robert Cecil then moved an amendment representing that, in the absence of a report by an independent body on the desirability of an agreement with contractors for the erection of a wireless chain, or on the terms of the proposed contract with the Marconi Company, the House ought to refuse its approval. After a speech by Mr. H. Terrell in support of the amendment, Mr. Herbert Samuel, the Postmaster-General, replied at length. After quoting the opinion of Lord Parker's Committee, Mr. Samuel read out the opinion of the Army Council, who declared it to be a factor of the highest importance in Imperial Defence that the wireless stations should be at once equipped. The Board of Admiralty held the same opinion—that it was essential that action should not be delayed. The Government, said Mr. Samuel, could not ignore these repeated representations of the authorities and departments responsible for the defence of the Empire. He pointed out that England was not alone among the countries of the world in employing a contracting company for the erection of long-range commercial stations, and he referred to what was being done in Germany, Norway and Italy. France recently had laid before her Parliament an elaborate scheme by the French Postal Administration for the erection of a large number of stations throughout the French dominions. That scheme was referred to the Budget Com-

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mittee of the French Chamber, who approved of the general idea, and recommended the French parliament to vote over £600,000 for the erection of a certain number of stations. In Canada it was not the case that any stations were being erected by the Poulsen Company, as had been represented in the House of Commons erroneously. What had happened was simply that the Canadian Government had given a licence to the Poulsen Company to erect a station at their own cost and at their own risk to carry on their own business, worked by their own staff. There was nothing in the nature of a Government station, and the Canadian Government were not paying a single sixpence to the Poulsen Company for this station.

The South African Government desired to erect a long-range wireless station, and were a party to the very contract under consideration by the House. The South African Government made independent inquiries into the Poulsen and other systems, and they came to the conclusion that their own proposals were right, and they asked to be allowed to be parties to this contract. Mr. Samuel laid stress upon the importance of securing the services of Mr. Marconi, and said that if Mr. Marconi were hampered in the conduct of his enterprise in this country the consequence would be that he would transfer it elsewhere. "I think," he added, "that would be a great disadvantage to the United Kingdom. He employs here hundreds of workpeople, he has equipped ships with wireless telegraphy, he has built the stations all round our coasts, his inventive power has resulted in the saving of lives of hundreds of people. I think it right to tell the House that Mr. Marconi has felt most deeply the way in which his honoured name has been made into a by-word, a political catch word, almost a term of abuse, so much so that he was most reluctant to enter into any personal obligation in the new contract, and it was only at my repeated personal requests that he consented again to sign the contract and to enter into a personal engagement on his own behalf. We get the advantage under this contract of his help and inventive powers. I wish to inform the House that he is now experimenting on a new machine, to which he attaches the greatest importance, and which will mean a very considerable economy in work. This machine cannot be substituted for the present machine, but it can be used for electrical disturbances." Mr. Samuel laid before the House the proposal of the Government for the future organisation of the wireless service. The stations when built, and others that had to be built in other parts of the Empire, would be under the control of the State. There was to be a small committee consisting of Post Office engineers and one or two from the Admiralty who would watch the erection of the stations, and consider technical problems from week to week. The Parker Committee would be maintained as a standing Committee, and Lord Parker had promised his continued co-operation. Further, there was to be an organisation for scientific research into problems of wireless telegraphy, and those connected with it would keep in touch with foreign discoveries.

Mr. Bonar Law then addressed the House, and he was followed by Mr. Asquith, the Prime Minister, who, speaking in support of ratification, explained that he was influenced by the important strategical considerations which were constantly brought before him. Two years had elapsed since the Committee of Imperial Defence came to the conclusion that it was a matter of the utmost urgency that this chain of wireless stations should be erected and brought into use; that nothing had been done was most disquieting. Speaking with a full sense of responsibility, he affirmed that the work ought not to be delayed even for another month, and as the Government could not undertake it the only course was to enter into a contract with the Marconi Company, and he commended the acceptance of this contract to the judgment of the House.

The divisions were then taken: in the first division Lord Robert Cecil's amendment was rejected by 221 votes to 140. The main question was then put, and was carried by 210 votes against 138. The agreement was accordingly ratified.

A White Paper (No. 217, July 31st, 1913) was issued prior to the debate containing particulars of the arrangement which were debated on and ratified in Parliament on August 8th.

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The B.A. at Birmingham

THE meeting of the British Association for the Advancement of Science, which will open in Birmingham on the 10th of this month, will be the fifth meeting which has been held in the metropolis of the Midlands. It is appropriate that Sir Oliver Lodge should assume the presidential chair, for he has done a great work for science and, as Principal of the University, a great work for Birmingham. His inaugural address is awaited with a great deal of interest, and it is believed he will make a wide and philosophical survey of the position of science in general, incidentally dealing with the discussions and controversies relating to the existence and the functions of the ether of space and the physical continuity of which it is the chief element.

The city is making active preparations to accommodate the British Parliament of Science; all the twelve sections composing the Association will be afforded ample accommodation for their meetings. Seven of the sections will be grouped in one of the University buildings, Mason College, and excellent quarters have been found for the other sections in Queen's College, the Midland Institute, the Technical School, and the Temperance Hotel. The Town Hall is to be used as a general reception room, and on September 11th the Lord Mayor will hold the reception of the delegates in the New Art Gallery of the Council House. As usual, there will be various garden parties and other social functions.

The subject list of lecturers and papers to be read at the meeting is not yet complete, but already there are several which should prove particularly interesting to THE WIRELESS WORLD. One is by Prof. Marchant on "Some Effects of Atmospheric Conditions on Wireless Signals," while Prof. Howe will discuss "The Nature of the Electro-Magnetic Waves employed in Radio-Telegraphy and the Mode of their Propagation." In the mathematical section there is to be a discussion by Prof. A. E. H. Love, Prof. E. Rutherford, and Prof. Pringsheim on "Radiation," while Mr. W. H. F. Murdock will read a paper on "A Direct Method of Measuring Magnetic Perceptibility and the Instruments for this Purpose."

BIRMINGHAM UNIVERSITY

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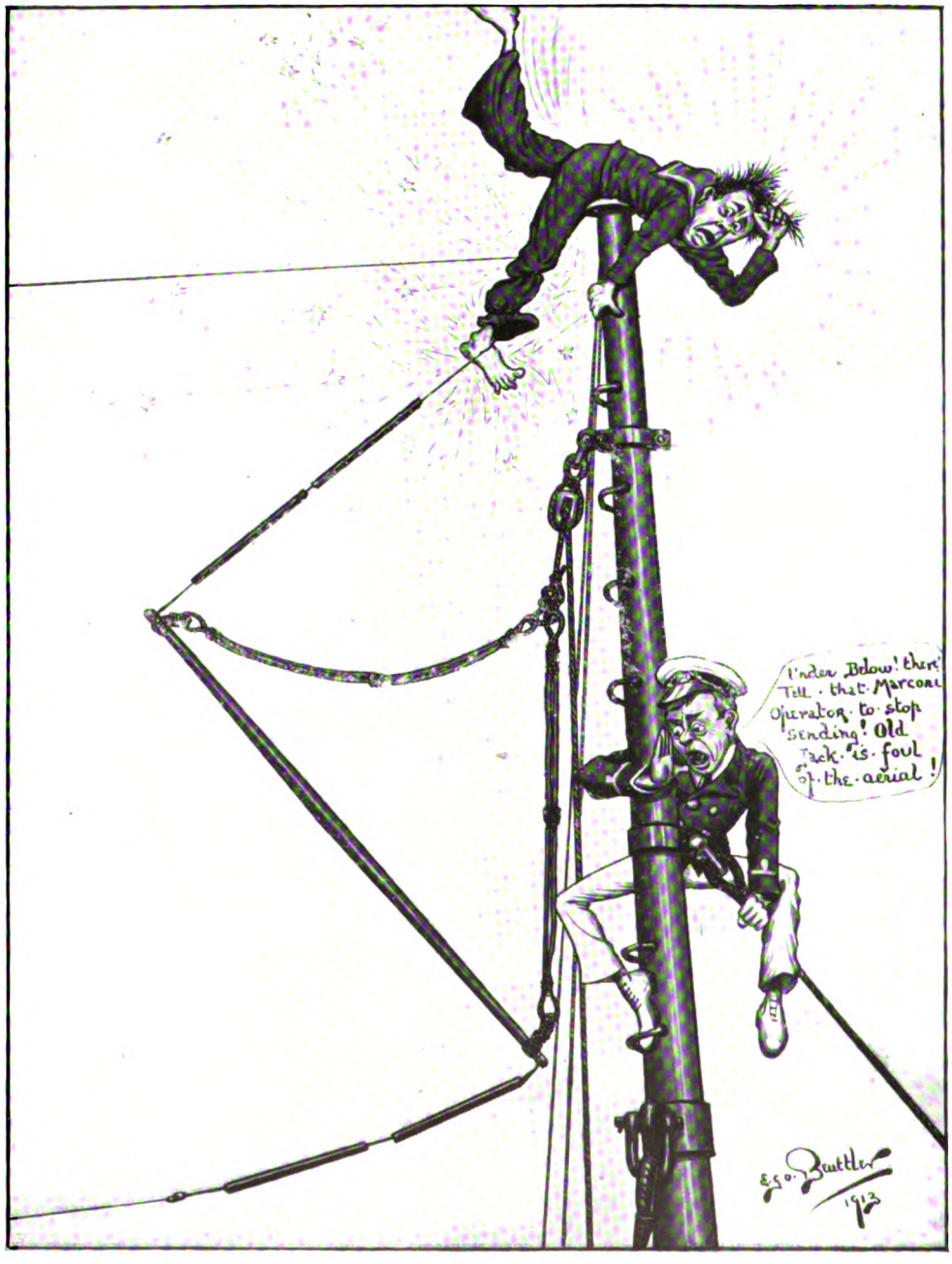
CARTOON OF THE MONTH

Wireless Terms Illustrated



VI.—A High Resistance

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A Lonely Land

A short account of St. Kilda and of the Wireless Station which has recently been erected there, and by means of which the inhabitants are at last able to communicate with the outside world.

THE weather is not pleasant, the air has not much warmth, half the year is deluged with rain. From the autumn to the vernal equinox a dry day is hardly known, except when the shadows are suspended by a tempest. Under such skies can be expected no great exuberance of vegetation. Their winter overtakes their summer . . . the autumn struggles hard to produce some of our early fruits ; I gathered gooseberries in September, but they were small and their skins were tough.

In some parts there is only a thin layer of earth spread upon a rock which bears nothing but short brown heather, and is not generally capable of any better product. The only fuel of the island is peat. Herds of goats and sheep are kept, and the goats' milk is made into cheese by the inhabitants of St. Kilda.

To the southern inhabitants of Scotland the state of the mountaineers and the islands is equally unknown with that of Borneo or Summatra ; of both they have only heard a little and guessed the rest. They are strangers . . . to the advantages and wants of the people . . . whose evils they would remedy.

Such were the impressions gathered by the great Dr. Johnson in his voyage to these lonely parts, which at that time was an expedition worthy of record, and which he memoralised in his *Journal of a Voyage to the Hebrides*. Curiously enough, the observations which he made at that time, and which are marked with that acumen which was the great writer's chief characteristic, afforded until a few weeks back a fairly accurate description of the loneliness of these lands.

St. Kilda is the largest of a small group of sixteen islands on the Southern Hebrides. Its greatest length, which lies from east to west, is three miles, its greatest breadth two. The cliffs of this rocky island rise sheer out of deep water, except at the landing stage, where nestles the little township which holds the entire community of this deserted island. In all probability St. Kilda was the core of a tertiary volcano, and to-day its highest point, "Conagher," reaches some 1,200 feet above sea level, but the island also contains Sandstone Hills, and the boldness of its scenery is softened in many parts by considerable richness of grass land. Its inhabitants in 1901 numbered 77, but this census shows a decrease in population, for once upon a time it boasted as many as 150 souls.

Potatoes, oats, and barley are cultivated, and about one thousand sheep and a few cattle are also kept. It is an odd fact that fishing, which one would have imagined to be the chief pursuit of the people, is practically neglected, though the same cannot be said of wild-fowl shooting. This affords both the pastime and business of many, and the bag is very varied, for it includes puffins, guillemots, petrels, razor-bills, and solan geese—which are used both for food and oil. Manufacture on the small scale is also indulged in, for coarse tweeds and blankets are made from the sheep's wool, which, by the way, is not shorn after the usual fashion, but is plucked from the sheep.

The whole land belongs to the famous

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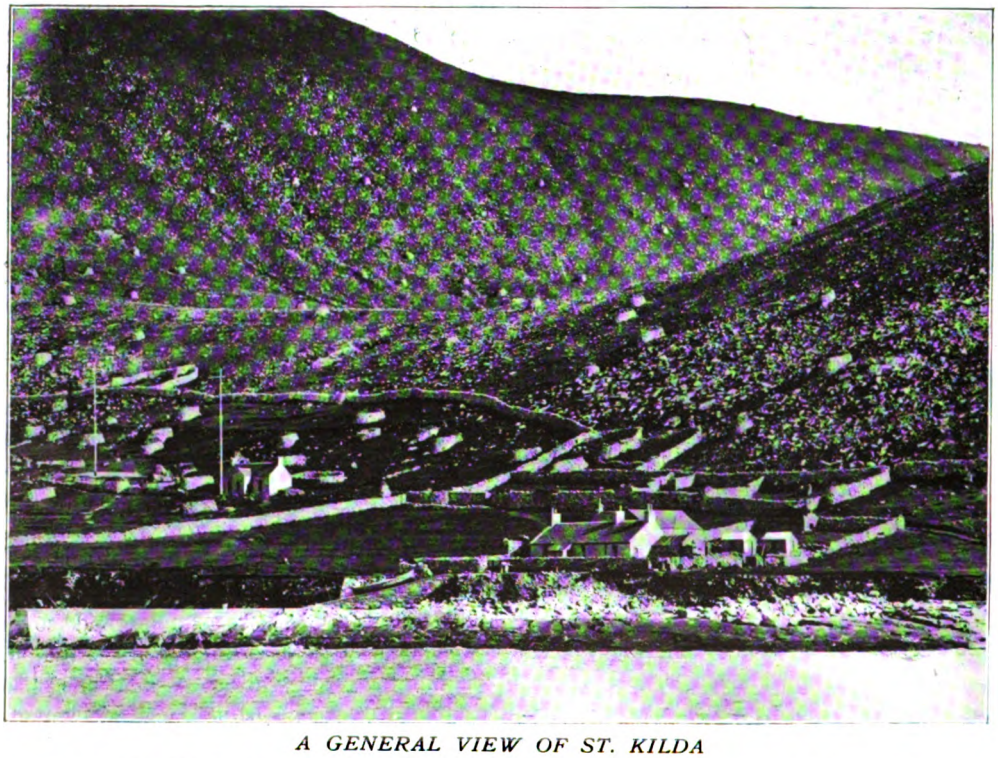
clan of the Macleods, of Skye, who purchased it in 1871 for £3,000, as since 1779 their ownership had lapsed, owing to the then laird selling his inheritance for a trifling sum. The island is inaccessible for eight months in the year, and the only means of communication was, until recently, by means of "sea messages." These were placed in strong wooden boxes which were despatched in the waves when a west wind was blowing, for then they drifted to the main land or the western islands of Scotland, and were due to arrive there within a week.

But through the generosity of the *Daily Mirror* all this has been changed. For the past year the severe straits to which the inhabitants were reduced, even to the extent of famine, has been the subject of a vigorous press campaign, and it has resulted at last in the erection of a Marconi station at St. Kilda, through the agency of the *Daily Mirror* and the generous aid of Mr. Gordon Selfridge, who contributed £100 towards the expenses. This was not before the necessity for some intervention had become urgent. Early last year the St. Kildans were cut off from the world and desperately short of provisions, so desperate that the *Daily Mirror* organised a relief expedition, and sent them provisions in a specially chartered tug. This year the islanders were stricken with influenza, and in danger of death owing to lack of medical attention. On this occasion the Admiralty was communicated with, and a cruiser was sent to the assistance of the islanders. Then it was that the erection of a station was decided upon, and Mr. Dudley Ward Miller, of the British Telegraph Instruments, Ltd., was appointed engineer in charge of the expedition.

The steamer carrying the requisite materials for the station steamed into St. Kilda on Thursday morning, July 10th, and



A GENERAL VIEW OF ST. KILDA

Its appearance to-day strikingly supports Dr. Johnson's description of the Island in his "Journal of a Voyage to the Hebrides." The newly-erected Wireless Masts are plainly visible.

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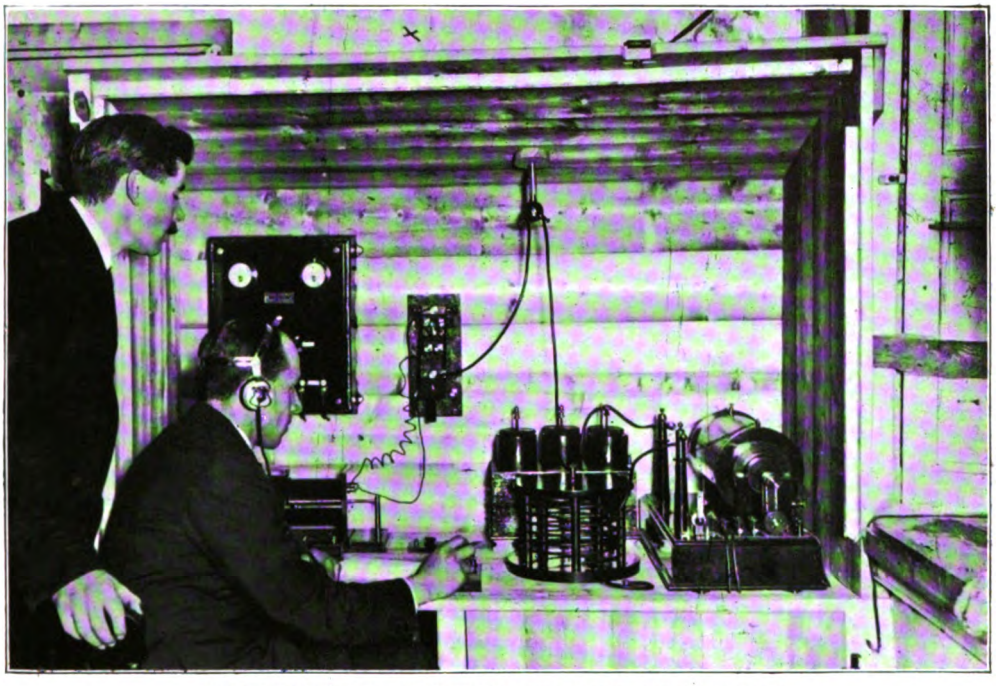

LEARNING TO MANIPULATE THE APPARATUS.

The "Postmaster-General" of the Island being initiated into his new work.

immediately a site for the station was selected. The gear and necessary provisions being landed, work was commenced in dead earnest; the huge 70 feet masts, which carry the aerial, and which had been cast in the harbour from the steamer, were hauled up. This was no light task, for they had to be hoisted up steep rocky cliffs, and in spite of the difficult nature of the operation and the weight of the masts—each was a ton and a half—the whole work was finished within 24 hours, and the station complete on July 22nd. Then the instruments had to be installed, and this could not be done hurriedly. Nevertheless, everything was in working trim by the 31st. On that day the correspondent of the *Daily Mirror* left the station for Lochboisdale, where there is a post-office wireless station, which has been commissioned to receive all wireless messages from or to St. Kilda, but we will leave him to tell his own story:

"When I bade farewell to St. Kilda, Mr. Ward Miller said to me:—

"'I shall speak to you in a day or two. We shall not be a lonely island any longer.

"We had already heard with remarkable distinctness messages sent from Poldhu, in Cornwall; the Eiffel Tower, in Paris; Nauen, in Germany; and other places, and but for the non-arrival of sulphuric acid for charging the batteries, we should have begun the transmitting tests.

"The acid, however, did not arrive until Tuesday, and it was late that evening before the work on the transmitting apparatus could be begun.

"I arrived at Lochboisdale, some sixty miles from St. Kilda, on Thursday night, and on the following morning Mr. W. N. Morgan, a post-office wireless operator, reopened the wireless station here, which had been closed since last April.

"So that at both stations there was a considerable amount of anxious work to be done before communication could be established.

"Mr. Morgan cast aside the limitations of the ordinary post-office hours and worked assiduously from eight o'clock in the morning until one o'clock the next morning.

"Occasionally he obtained faint traces

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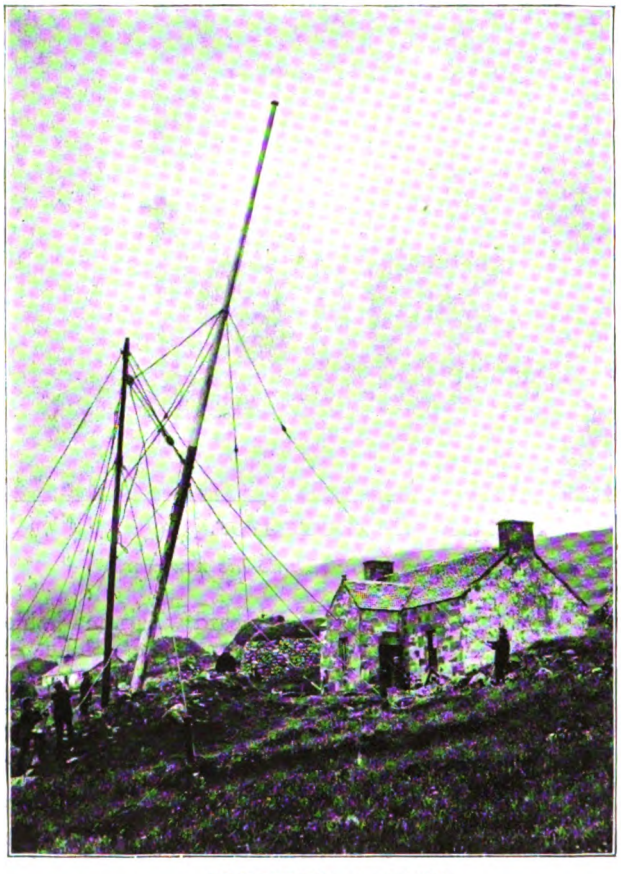
that on the other side Mr. Ward Miller was working just as energetically.

"But Mr. Ward Miller was having some trouble in getting through his signals. A series of V's—the letter always used when wireless tests are made—could scarcely be heard.

"But both sides persevered, and the reward came at nine o'clock last night—three working days after the tests had started.

"Before leaving St. Kilda I arranged that the code letters to be used for calling up the station should be 'T.D.M.'—the initial letters of the title of *The Daily Mirror*



ERECTING A MAST

This was the most difficult part of installing the station, for each mast weighs a ton and a half and the island is very rocky.

"At nine o'clock last night Mr. Morgan called 'T.D.M.' promptly, and with joyous repetition came the reply, 'O.K. O.K. here. St. Kilda. Who are you?'

"The dots and dashes were quite clear. We at once replied:

"'Here. Lochboisdale. I am getting you O.K. Send V's for fifteen minutes.'

"St. Kilda responded: 'Here — St. Kilda—St. Kilda — St. Kilda—St. Kilda—I have a message for his Majesty the King when you are ready.'

"And then, with the telephone receivers to his ears, Mr. Morgan, in that dim light of an oil lamp, took down the message which the inhabitants of St. Kilda wished to be sent to the King on the opening of the station.

"Quickly and distinctly the words came through the air. It was the first telegraphed message of any kind that had ever been sent from the island in the Atlantic.'

"This loyal salutation called for the following reply:

"'*The King desires you to convey to the inhabitants of St Kilda his sincere thanks for the loyal message which you have addressed to his Majesty on their behalf.*

"'*His Majesty trusts that your improved communication may be the means of improving the welfare and happiness of his subjects in St. Kilda.—Equerry.*'

"With the installation of the wireless station, St. Kildans for the first time in their history are able to know the correct time. Hitherto it has been roughly guessed by the sun's position.

"I shall long remember the islanders' amazement at the wonders of wireless — their astonishment when they were told the exact Greenwich time and various items of the world's news picked up by the operator."

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Steam Trawlers and their Work

The Fisheries of the North Sea. The Ousting of the Fishing Smack by the Steam Trawler. Life under the New Régime, its "Pros" and its "Cons." The Efforts made to Ameliorate these Conditions. The Introduction of Wireless on Steam Trawlers.

WHAT is the cost of our fish markets, and what is the price paid for our breakfast delicacy or our evening's *sole au gratin*? It cannot be reckoned in mere dollars' worth, for our supply of fish is only bought by hardship and peril and even life itself.

This harvest of the sea which daily fills the markets of Billingsgate and Grimsby is not gathered without great toil, and always, even under the most favourable conditions, with a certain amount of risk; but the general public know little or nothing of the life and work on a steam trawler, so a few facts may be of interest to the reader before the subject of the wireless equipment of a steam trawler is touched upon.

The great fisheries of England are in the North Sea. The Dogger Bank has been called the Charing Cross of the North Sea, for it is there that all known fishermen meet. The fleets are constantly on or near the Dogger. The steam carriers surge up London river from the Dogger, and it is back to or near the Dogger that they mostly go when they are clear of Billingsgate, or Gravesend. The steam trawler is now practically the only class of vessel employed in fishing, though at first it nearly succumbed to the opposition of the fishermen, who are perhaps the most conservative race of beings in existence, and who for a long time urged that the steam trawl made the fish unfit for market, as their insides were broken and the galls burst, and further that in areas where the trawler was in use the fish diminished in quantity and deteriorated in size. Of course, these notions were forced to give way before actual experience. There are three kinds of these vessels: the fleeters, the single boaters, and the Icelanders. The fleeters are the smallest, and carry enough coal and provisions

A Hull Fishing Steamer fitted with special masts and Marconi apparatus.

to last them about six weeks, during which time they stay on the fishing ground and deliver their catch of fish every morning to the carriers. The single boaters leave port for some particular ground on which fish is likely to be found. This may be fifty miles or more from the coast, and if a trial trawl on a likely spot is productive of good results, a buoy called a "Dan" is placed in the sea to indicate the location of the fish, and the neighbourhood is worked either until the fish leave it or the catch justifies a return to the port. As the fish is caught it is gutted, boxed, and iced, and put in the steamboats' fish-room. The third class is composed of the

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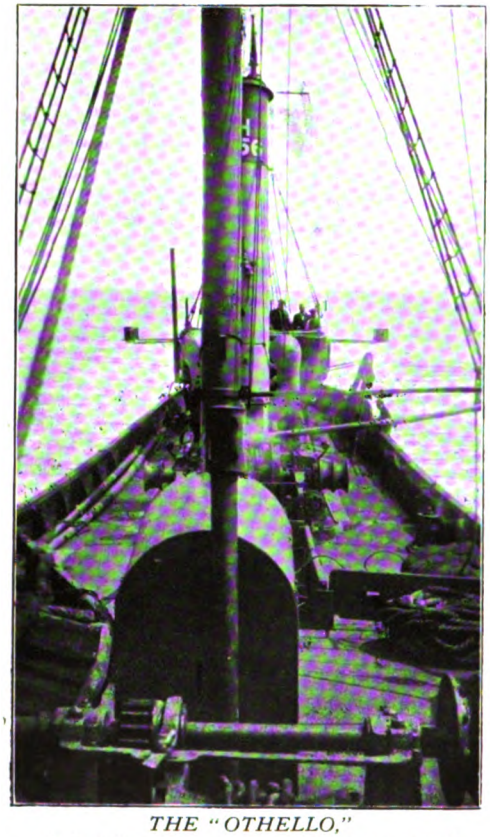

THE "OTHELLO,"
A trawler which has just been equipped with a wireless installation.

larger vessels, which during the season go to Iceland and the White Sea, spending three to four weeks on the trip, and bringing home large cargoes of fish which realise sometimes as much as £1,000, the result, however, depending very largely on the state of the market. From stem to stern the "Icelander" is crowded with appliances. There is the cabin, the engine-room, boiler-room, coal bunker, reserve bunker, fish and ice-room, store-room, and the forecastle, which contains accommodation for about eight men. These vessels have proved so successful in working long voyages that to-day energetic measures are being taken to organise fleets of trawlers for Australian and Japanese waters.

All the fish that are trawled from North Sea waters are divided into two great classes, prime and offal. The prime is composed of the upper kinds of fish, and the fish of the lower orders constitute the offal. Soles come an easy first. Nothing pleases the fisherman more than a good haul of this aristocrat of the deep, for however erratic the market may be, there is always a sure profit on the catch. Turbot comes next, then brill. The offal comprises many sorts of fish, especially haddocks, halibut, gurnet, whiting, and skate. All those mentioned find a constant market at Billingsgate, but there are others which are not considered worth offering as regular lines, though here again there is often a local market. A good instance of the varied taste in this respect is afforded by the skate. On the German side of the North Sea, this fish almost ranks as prime, while in England it is still despised as scarcely worth the eating—not so much now as it used to be, for it is becoming extensively used at restaurants where good cooking can transform it into a dish fit for the menu of the unsuspecting.

The condition of the market that is most dreaded by the North Sea fishermen is when there is a glut, for the fish which may have taken him many days' care to procure must then be sold at a price that compensates him for not a tithe of the labour and expense of fishing. A Yarmouth resident once stated that many a time he had seen fresh herrings sold for a hundred a penny at the fishwharf, and even thrown away as worthless. This condition of things, however, is not as bad as it used to be. Steam has accelerated and equalised speed, so that good fishing localities can be followed up with greater regularity. Another thing that the introduction of steam has done is to minimise delay in transport. This has had a most beneficial effect on the market, for nowadays foreign buyers make a point of visiting the English markets and often large deals are transacted with the salesmen, so that in many instances a "catch" may never be unshipped but bought *en bloc* and the carrier ordered to take it straight away to the foreign port named by the buyer. This is a very different condition of things to what prevailed in the days of the old fishing smack, for then it was no uncommon occurrence, especially in summer time, for a whole fleet of vessels to be becalmed, when the fish stored in the hold of each boat would soon become unfit for food and require to be thrown away.

Again, steam has enabled fishing operations to be carried out on a more organised plan. Nowadays a fleet will make a campaign on

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some likely spot, and trawling will be done by everybody in unison. Such, for instance, is "Sellier's Fleet," which consists of seven carriers and fifty-five fleeters.

Although there is nothing approaching the rigid discipline of the Royal Navy, still these fishing fleets are very carefully controlled by an experienced fisherman, who is officially known as the "Admiral," but familiarly as the Boss. This admirable Admiral is responsible for the fishing operations of the fleet. Nothing is left to chance, for both night and day there are certain signals given, to which the skippers shoot or haul their gear. In the daytime signals are made by means of flags. The regular night signals are, one green rocket when the gear is to be shot, and the trawl is to be on the starboard tack, and corresponding one and two red rockets to port. Two white rockets is the signal for the trawl to be hauled. With each fleet, there is what is known as a mark boat, which is to indicate the rendezvous of the trawlers when they assemble for the purpose of sending off their fish to the carrier. Operations are usually conducted within a radius of ten miles off the mark boat. There is nothing more impressive than this hauling of a North Sea trawl, especially at midnight. All around is a vast solemnity of water, spangled with the bobbing lights of the floating town, which has a population of some 500 men. The steam winches are wheezing and clanging, and the wheels of miscellaneous mechanism are rattling with sudden stoppages and spasmodic starts. Suddenly the conflict ceases. There is a sizzling of water, a quick lashing of what seems to be a complicated knot, and then the slithering mass of fish. There is at once a greater splashing and clashing, for the gear is overboard again, and the trawl which had scarcely rested, is scooping up and collecting more fish.

You have heard the curt command "Right over!" and the next you know is that men are knee deep in pounds of slithering fish, and that cutting knives are being fiercely plied.

But the life of a North Sea fisherman is not all *couleur de rose*. "I reckon," a whaleman was once heard to say, "'at no man but a fool who wasn't forced would go fishin'. It's sixteen weeks since I left my wife—and I'm pinin' to see her again. She'll be goin' to church by this time, and there's so much work to do and so little for it when it's done."

A GROUP ON THE "CÆSAR."

The success which attended these experiments with wireless seems to be mirrored in the faces of the experimental party, for they look "jolly good company every one!"

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PACKED AND STORED IN THE CARRIER.
Fish in the hold of a Carrier ready to convey it to Grimsby.

But there are many humanising agents at work now. Steam is one of them, for it minimises the precariousness of the life, and shortens the periods of absence from home. Another is the splendid work done by the Royal National Mission to Deep Sea Fishermen, who do wonders with their hospital and mission ships, for by this means doctors travel with the fleet, and the sick and injured can be cared for, bringing besides the little luxuries of life, such as warm clothing and good literature, to the toilers. The latest addition to the fishermen's welfare is wireless telegraphy. Only recently an interesting experiment was carried out by the Marconi Company with a view to determining the extent to which wireless telegraphy could effectively and economically be applied to steam and fishing vessels. The result of the experiments was to show that it would be an invaluable asset, and the idea is to instruct skippers and fishermen in the use of it, for it can be employed not only in fishing operations, but in giving notice of approaching storms. Furthermore, for a long time it has been recognised that the conditions of modern steam trawling demand that some means of communication with the shore should be effected, and there is none that is capable of fulfilling such a purpose except wireless telegraphy.

By courtesy of Messrs. Hellyers' Steam Fishing Company, Limited, of Hull, the Marconi Company had at their entire disposal for several days the trawler *Othello* and the carrier *Cæsar*, and as the result of tests carried out some highly useful data were obtained. Having regard to the size of the trawler, its mast facilities, and the kind of work carried on by a vessel of this description, it was decided at the outset that the most suitable form of wireless equipment would be a type approaching as nearly as possible the Marconi standard ½ kw. set. Two installations of this power, but of somewhat different design, were therefore placed aboard the trawler, and light topmasts were added to carry the aerials. An average range of ninety miles was aimed at. With regard to the carrier, the duties of which would be likely to call for a considerably increased range, it was decided that liberal provision — within reasonable limits, of course—should be made, not only as regards the power of the equipment, but also as regards the height of the masts. The existing masts of the *Cæsar* were taken out of her, and two new wooden masts, providing a height of a trifle over 100 ft. from the water-line, were put in their place. Two types of Marconi 3 kw. stations —one of the pattern generally used in the mercantile marine, and the other of a portable military description—were installed. Neither the trawler nor the carrier possessed any electric light equipment, so it was necessary in each case to provide sufficient electric power to work the wireless installations. In the *Othello* the two types of installation, being of small power and very compact, were accommodated in a small mess-room aft, whilst the steam engine for supplying current was placed in the ship's engine-room, and an oil engine which, for the purposes of drawing comparisons, was also employed, was put in the fore 'tween decks. On the *Cæsar* recourse was had to the main hold. By the courtesy of the British, German, Norwegian, and Dutch authorities controlling wireless stations in the North Sea, the experiments were greatly facilitated. The vessels left Hull on June

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11th, and proceeded across the Dogger Bank towards the coast of Denmark. At a distance of 270 miles from Cullercoats, the *Cæsar* sent and received messages without difficulty; thus the estimated range of between 180–200 miles was considerably exceeded, and the strength of signals in both directions was such as to indicate that the range of 270 miles could have been increased still further. With the *Cæsar's* aerial lowered to 65 ft. above the water level she communicated with Scheveningen at 195 miles. There were good strong signals both ways, and messages were freely exchanged. The *Othello* with her plant was able to communicate with Cullercoats, 180 miles away, messages being freely exchanged at that distance, and also with the *Cæsar*, a distance of 100 miles, with the latter ship's aerial at 65 ft. above the water. Of course, it must be understood that the operators were working under considerable difficulties, the peculiar movement of these small vessels making them very sea-sick and constantly throwing them about. In consequence of the very satisfactory results of the tests, Messrs. Hellyers immediately placed an order with the Marconi Company for one installation of the type fitted on the carrier *Cæsar*, and three installations of the class fitted on board the trawler *Othello*.

A bronze tablet, designed by Henry Bacon, the eminent New York architect, to mark the site of the first public telegraph office in the United States, has been placed on the wall of the old Post Office Department building, on Seventh Street, N.W., between E and F, in Washington, D.C., and was dedicated on July 4th.

The inscription on the tablet reads :—

"Samuel F. B. Morse, artist and inventor, opened and operated on this site, under the direction of the Post Office Department, the first public telegraph office in the United States, April 1st, 1845. 'What hath God wrought.'"

TRAWLERS AT HULL.

One of the largest fish markets in the world.

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Administrative Notes

Austrian Coast Stations.

The following Austrian coast stations were officially opened for general public correspondence on July 1st:

Trieste (O.H.T.).
Castelnuovo (O.H.C.).
Sebenico O.H.B.

All these stations will maintain permanent watch. The station charge will be 20 cms. per word, with a minimum of fr. 2 per radiotelegram. The coast station at Pola is now no longer open for public service.

* * *

Revised British Regulations.

In view of the revised regulations relating to radio-telegrams, which came into force on July 1st, the British Post Office issued a new set of instructions. The principal alterations affecting the treatment of radiotelegrams are as follows:

(1) Radiotelegrams can be *forwarded* at the risk of the sender to a ship *through intervening ships* (not more than two in number). An additional charge of 4d. a word with a minimum of 3s. 4d. must be collected if one retransmission only is desired; or 8d. a word with a minimum of 6s. 8d. if a radiotelegram is to be retransmitted through two ships. The instruction "——retransmission télégraphe" or "——retransmission lettre" (the blank space to be filled up with the number of retransmissions required) must precede the address and be charged for as three words. In the former case the telegraph charge for a reply of 5 words from the coast station must be prepaid, and in the latter a charge of 2½d. is collected for a letter from the coast station. The coast station will inform the office of origin by wire or letter, as the case may be, if one or both the retransmissions asked for by the sender were necessary to reach the ship to which the radiotelegram was addressed. If the message can be sent direct to the ship to which it is addressed from the coast station the whole of the sum deposited for retransmission will be refunded. If two retransmissions are paid for, but only one was found to be necessary, the balance of the charges due will be refunded.

(2) Radiotelegrams can be sent to a ship to be *posted* as letters *at a port of call*. A fee of 2½d. in addition to the ordinary radiotelegraphic charges is payable in such cases. The radiotelegrams should be addressed in the following form:—

——Poste Buenosaires——Smith 14 Calle Prat Valparaiso Avon Lizard.

(3) The *name of the ship* in the address with the call signal which must be added where it is given on pages 889–898 of the Post Office Guide is *now counted as one word* irrespective of its length. Similarly the name of the coast station in the address is counted and charged for as one word.

(4) The sender of a radiotelegram may *prepay a reply* of any value. The instruction—R.P.—followed by mention of the amount prepaid, must be entered in the service instructions and telegraphed, as well as before the address. The amount prepaid should be expressed in sterling currency—*e.g.*, "RP 15/6," the whole expression counting as one word.

(5) The sender may request the coast station to *notify* him of the *date and the hour* when the *radiotelegram was transmitted* to the ship to which it was addressed. The information can be transmitted at the sender's option by telegraph or letter, and sufficient must be prepaid in the former case to cover a telegram of 5 words from the coast station, or, in the case of a letter, 2½d. will be collected. The instruction "PC" or "PCP," as the case may be, must precede the address of the radiotelegram and be included in the chargeable number of words.

Radiotelegrams to be *repeated or collated* may be accepted in accordance with Rule 42 of the Instruction regarding Foreign and Colonial Telegrams.

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Australian Stations.

THE opening of the Port Moresby (Papua) and Thursday Island stations for the transaction of public and official business has been officially notified. Each of these stations gives a continuous service, and the charges have been fixed as follows :

ORDINARY MESSAGES.

For Ship-shore Communication.—Sixpence per word radiotelegraphic charge, without minimum, plus Commonwealth land-line charges.

For messages sent from the Commonwealth to Papua.—One penny per word per radiotelegraph station, plus Commonwealth land-line charges—*i.e.*, in addition to the land-line charges one penny per word will be charged for handing the traffic at Thursday Island wireless station, and one penny per word for Port Moresby station.

For the present delivery charges, if any, will be collected from the addressee.

PRESS MESSAGES SENT BY WIRELESS TO AND FROM PAPUA.

The present press land-line charges within the Commonwealth, viz. :—

	Within the State in which the Wireless Station is situated.	Other States.
	s. d.	s. d.
Not exceeding 25 words ...	0 6	1 0
Exceeding 25 words but not exceeding 50 words ...	0 9	1 6
Exceeding 50 words but not exceeding 100 words ...	1 6	3 0
Every additional 50 words or portion of 50 words ...	0 6	1 0
Plus a wireless charge as follows :—		
Not exceeding 25 words		2 6
Exceeding 25 but not exceeding 50 words		5 0
Exceeding 50 but not exceeding 100 words		10 0
Every additional 50 words, or portion of 50 words		5 0

* * *

Stations in the United States.

The functions of the United States Bureau of Steam Engineering are set out in an official communication recently issued. This department is charged with the manufacture, installation, maintenance, inspection, alteration, repairs of and requisitions for all radio installations ashore and afloat as far as radio material and other equipment of radio stations are concerned; with tests and experiments of all radio apparatus; and with the preparation of technical instructions concerning the operation of such apparatus. The department maintains close relations with the Superintendent of radio stations to ensure co-ordination of all radio work, and prepares the estimates for all radio expenditures. Each coast radio station is under the direct control of the commandant of the naval station within which it is situated, unless specific orders have been issued to the contrary. In this case a duplicate of all inspection reports pertaining to the station is sent to the commandant of the naval station. Any coast radio station not lying within the limits of a naval station is under the control of such officer as the department may direct. The maintenance and inspection of material of coast radio stations is performed by such navy yards as are appointed for the purpose by the Bureau of Steam Engineering.

* * *

Safety at Sea.

IN reply to a request from Senator Fletcher, of Florida, asking for a review of what has been accomplished by the Department of Commerce in way of providing for the safety of life at sea, Secretary Redfield submitted an interesting report, in which he referred as follows to the subject of wireless telegraphy :

> You helped to frame the acts of Congress concerning radio-telegraphy and aided in the ratification of the Berlin and London radio-telegraphic conventions, so I need not tell you that on this subject the legislation of the United States, in principle and in most of its provisions, already has been accepted as the basis for the international prescription and regulation of this far-reaching agency for the promotion of safety at sea. The principle of a constant wireless watch on ocean passenger steamers (two operators) as a measure of Government regulation, to which there is now no dissent, was first proposed by my colleague, the Secretary of State, Hon. William J. Bryan, in November, 1911. Our own act of June 24, 1910, has been amended in accordance with this suggestion, and at the international conference last June in London, 31 countries approved the principle of a constant wireless watch, at least in the case of large passenger steamers, as a measure of international regulation. The same convention also provided for auxiliary apparatus for use in event of the failure of the ship's main power plant, as does our act of July 23, 1912. So far as radio-telegraphy is concerned, the work, from our point of view, before an international conference, will be mainly the adjustment of minor differences between our regulations and those which may be suggested by other powers, so as to secure uniformity. To prepare for this work I have requested the wireless companies furnishing operators and apparatus for ship and coast stations and the shipowners concerned to propose the names of suitable experts who may confer with the Commissioner of Navigation and representatives of the Naval Radio Service and the Bureau of Standards.

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Photographic Recording Apparatus

Addition to Liverpool University Wireless Equipment

PROFESSOR E. W. MARCHANT, the David Jardine Professor of Electrical Engineering at Liverpool University, has done, and is doing, much to produce accurate data in connection with wireless telegraphy. The university possesses, thanks to the generosity of Sir William Hartley, a wireless telegraphy installation which is capable of receiving messages from all parts of the world, though the licence granted to the university is, of course, only for scientific purposes. Sir William Hartley has quite recently made another gift to this branch of the university's work in the form of a new photographic recording apparatus for wireless signals. This apparatus takes photographs of the strength of the electric waves, and daily records are being collected from Paris and other places. These show the barometric pressure, the direction and the force of the wind, and the state of the sky and the sea.

The new apparatus at the university is intended to enable exact measurements to be made of the strength of the signals received from day to day. The current through the detector is passed through a specially-sensitive Einthoven galvanometer. The latter consists of a powerful magnet between the poles of which is placed a thin silvered quartz fibre about 1–10,000th of an inch in diameter, through which the current from the detector passes. A shadow of the fibre is thrown on to a plate, and as the plate moves the vibration of the fibre is recorded. By this arrangement it is possible to show the effect of every spark that is made at the Eiffel Tower station in Paris. On one or two occasions it has been possible to detect slight irregularities in the sparks at Paris. Observations are being carried out with this apparatus as to the effect of different atmospheric conditions on the strength of the signals received. Recently, by arrangement with Commandant Ferrié of the Eiffel Tower station, a series of signals was transmitted between the hours of 7 and 10 p.m., and an interesting set of photographs was obtained which showed the sudden increase in the strength of the signals just after sunset. Within half an hour the strength of the signals increased by nearly 70 per cent. It is intended to make a continuous series of observations with this apparatus so as to obtain a record of signal strength which will throw some light on the variations which are known to occur in wireless.

As is well known, the strength of the electric waves in wireless telegraphy varies; for instance, during the daytime it is found necessary to use a stronger current than that needed during the night. Again, there is a sudden intensification of wireless signals from America just after sunset. How and why this occurs has not yet been definitely discovered. But it is hoped that, by means of research work which will be possible with the recently-installed instrument at Liverpool University, some light may ultimately be thrown upon this unsolved problem of wireless telegraphy.

At fixed hours each day the time signal is recorded and the weather report compared with that published by the Meteorological Office.

The apparatus can be used also for the reception of rapid signals. The method by which this can be done is as follows: After the photographic plate has registered the vibrations of the quartz fibre, it is taken out of the camera and developed, when the message it holds can be read as easily as the dots and dashes of the Morse code on a tape machine. The daily observations which are now being made should prove of interest and importance in giving accurate data of the variation in strength of wireless signals under different atmospheric conditions.

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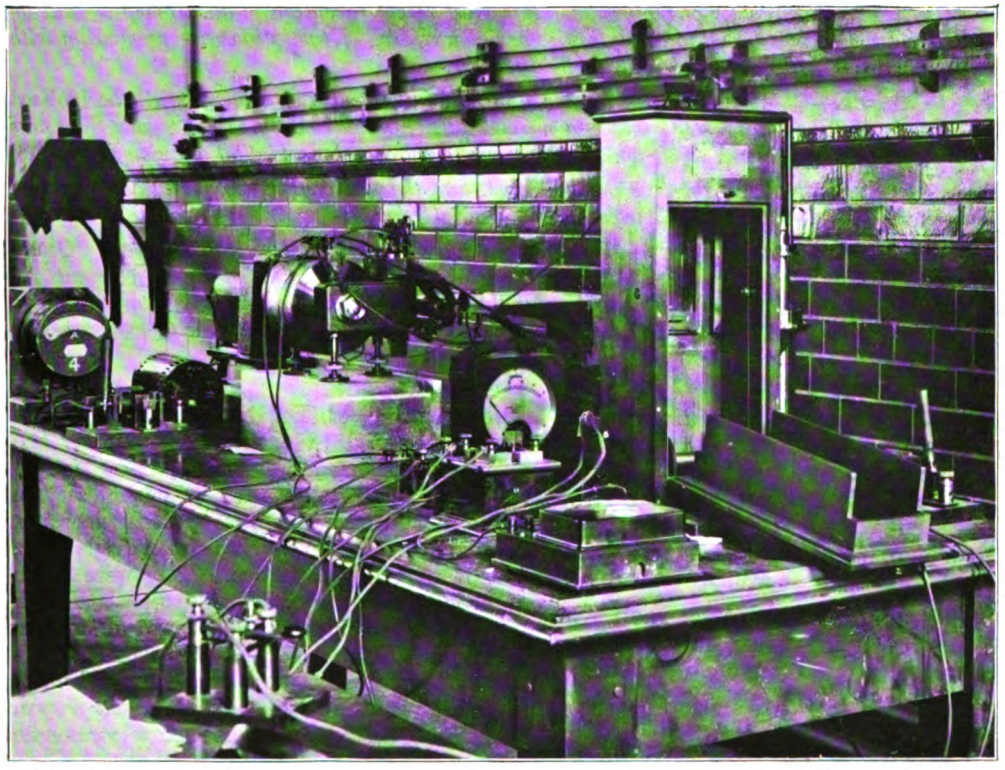
MIMIC WARFARE AT EARL'S COURT

THE readers of THE WIRELESS WORLD should go to the Imperial Service Exhibition which is now in progress at Earl's Court. There they will find many things of great national, and more than national importance. Perhaps one of the most striking sections of the exhibition is that devoted to naval affairs. As one enters the grounds from Warwick Road, one comes on the scene of a naval harbour, made particularly realistic by the reproduction, actual size, of the stern of H.M.S. *Lion*. Those who do not know what the interior of a man-o'-war is like will be able to spend an interesting half hour here. But perhaps the mimic war is the most fascinating of all the exhibits. Upon a large sheet of water, with a broad and deceptive background of scenery which might be the coast of Dalmatia, four model battleships, two battle cruisers, and two destroyers will go through various review formations, and will then bombard the town on the coast. After a plucky resistance, it is compelled to surrender, upon which a landing party goes ashore and hoists the Union Jack. But the battle is not confined entirely to sea tactics; aeroplanes and an airship play their part, and, what is most interesting, they are propelled by "wireless." Their manœuvres are marvellous; explosives are dropped from the dirigibles on to the battleships, and the sensation caused by the unexpected onslaught of these "bolts from the blue" can scarcely be described; to see vindictive bombs dropping unceremoniously from nowhere on to the unfortunate vessels which are quite incapable of retaliation on their aerial foes awakens the imagination to an unwonted pitch of excitement. But, actual as it is, to the lay mind it seems all so unreal. As someone aptly described it, it was like a chapter of H. G. Wells turned into action, or Tennyson's "Peep in the Future," translated from Locksley Hall to Earl's Court to make all the world wonder.



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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire. His most recent invention is an airship worked by wireless, which is likely to revolutionise aerial warfare. Negotiations are proceeding with the War Office for its purchase from the inventor.*

GWEN THRALE.—*Charles Summers' fiancée, a bright, intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society. She coaxes Summers to teach her "wireless," and soon becomes a proficient operator and a bit of an engineer.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip. They are discovered and "tapped" by——*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly they belong to the leisured and wealthy class; but in reality they are secret agents for a foreign Government sent over to England for the purpose of securing military or naval secrets. Their attention is directed to Summers' work, and they determine to get possession of the airship's plans.*

CHAPTER VI. (*continued*).

THE old questions of naval and aerial supremacy were once again very much to the fore. The daily journals were spending great columns of type on the trend of events. Huge staring letters spread the war scare on the evening placards.

ANOTHER HOSTILE SPEECH FROM THE CHANCELLOR.
GERMANS INSULT ENGLISH TOURISTS.
PROPOSED INCREASE IN GERMAN BATTLEMENTS.
THREATENED INVASION OF ENGLAND BY AIR.
ENGLAND'S UNPREPAREDNESS, etc.

All such topics filled the Press till the whole country seethed with indignation. Exactly why, it would have been difficult to state. Nevertheless such indications were sufficient to show that however long the evil day might be put off, there would at last come a time when the two nations would be at death grips to decide which should hold the supremacy of Europe. If Beulner as a German had been affected by all this turmoil it would not have been surprising, but what was extraordinary was the fact that while he remained comparatively calm on the subject, Dupont became more and more excited in exact proportion as the newspaper headlines became more flaring, or the statements in Parliament became more violent. Then, too, the telegrams, which had at first come to him in single spies, now came in battalions. They were all in code, which he could only translate with Beulner's help, and all were of foreign origin. Nearly every one of them necessitated a reply, and some of them would make him swear in the very finest *lingua franca*. Often after the receipt of such telegrams he would order the grey motor car, and go down to Sotheby for a week-end. Usually he stopped at the Granby Hotel, though sometimes, in order to avoid remark, he would put up at Chittingham. He soon came to know the country by heart, for in his car he toured every road, every side track even. He made his way to the lower ridges of the town, and always appeared to be on the look out. There was no doubt that on many occasions he was anxious to find out if Doss and Suk were in the neighbourhood, and sometimes his efforts were successful. He never passed them without speaking. Sometimes he would offer money. That was when he heard something which

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pleased him; but usually his efforts to obtain news were unsuccessful, and he would come away frowning at his ill-luck. Nevertheless, in this way he learnt all about the repairing course which the Summers airship was undergoing, and as matters progressed, so he became more and more cheerful, more *debonnaire*, more suave—more *à la* Dupont. Occasionally he would lay himself out to meet Miss Summers and make inquiries, but not too often, lest she should be suspicious; and never did he put himself in the way of Summers if he could help it. What he liked best to do was to hear from Suk that these interesting people were going to town, and would be doing this or that. Then he would manage, by hook or by crook, to come across them, and perhaps just pass the time of day. No occasion was he known to slip which might be turned to profitable advantage. Certainly Dupont was a very clever and determined man.

All this while Gwen was making great strides with her wireless. There was some reason to be gratified at the disaster, for it's an ill wind that blows nobody any good, and it served a good turn by giving her an opportunity of becoming more particularly useful to Charles. By this means she obtained a much more accurate and practical knowledge of the ship construction than she would have done by any number of theoretical lessons. She became quite an adept even in construction, and Summers soon learnt to call her in for little jobs which her more delicate fingers enabled her to finish off in neater fashion than he could ever have done. Then when the time came for little trial trips she learned how to get a far from perfect instrument under control. Perhaps something in the model would not balance rightly, so that the airship steered all lopsidedly, and the fault had to be rectified on the keyboard. Now, if Gwen had worked with a complete model she would never have been required to know such things. As it was, she became as proficient in the art of steering as Charles himself, and the latter soon had reason to be proud of the partnership of Summers and Thrale.

But however smoothly things went, many months necessarily elapsed before the mischief to the airship was rectified; for not only did the machine require extensive repairs, but, in Gwen's particular phrase, there were "other fish to fry." She had to be taught wireless telegraphy, and that took up many an evening which would otherwise have been devoted to airship construction; for although her struggles at the Morse code were heroic, even with the best will in the world one cannot learn a new language quickly. Besides, she had to learn something about the apparatus, so that her education occupied a good deal of Summers's time. After this another idea was brought forward, which also proved a good deal of hindrance to Charles in his work. It was suggested and finally decided that a wireless station should be erected at Thrale Hall, with the view of establishing communication between these two centres of attraction. Of course Charles made most of the machinery, and Gwen helped in a small way, but it took some time to get such apparatus into working order, and the spring of the following year was at hand before communication with Thrale Hall and the Vicarage was opened up. Gwen's set was pigmy compared with that of her professor, but it served its purpose very well. Many were the confidential messages transmitted between the stations, and often "x's were strong." Carried away by his enthusiasm, Charles did not realise how much his own work was being delayed. When he did he buckled to with a will, but it was another month or two before the airship was as sensitive an instrument as it was before the accident. As soon as it was completed to his satisfaction Summers approached the War Office in the hope that the Government might purchase his invention, or at least allow him opportunities to build a full-sized model for the purposes of demonstration. The procedure followed the usual course, and more months were taken up in negotiations, so that it was something over a year before things were sufficiently advanced for Charles to announce that matters were practically settled, and he would be allowed to demonstrate his invention before the Aeronautical Authorities with a view of its acquirement by the War Office. Great was the excitement of the two when so much was successfully concluded. Gwen felt that she had a right to feel proud of her *fiancé's* success, for had she not broken the machine for him and helped

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to put it to rights ? Besides, now that she knew all about wireless telegraphy, she could appreciate points which were outside the ken of the layman.

But Dupont had not been idle all this time. He had watched proceedings closely but cautiously, and he made innumerable opportunities of getting into closer touch with Miss Thrale. Presently he found his task becoming more and more difficult, and he waited in vain for a renewal of the invitation to watch the manœuvres. Finally he decided he could wait no longer, so he adopted bolder tactics, which were ultimately crowned with success. One day he motored down to Sotheby and put himself in the way of meeting Gwen and Charles. From conversation with the yokels, who by now were accustomed to him and the grey car, he informed himself of the time and place where it was most likely he would meet the two together. Armed with a sketch book, palette, paints, and the camp stool of an artist, he journeyed to a likely spot, and made active preparations for a sketch. Presently the two passed, and it goes without saying, there was a most delightful *rencontre*. Both parties expressed their surprise at the meeting, and Dupont, with the usual disclaimer of any pretensions to skill, showed them his effort. He was really a clever water-colour artist, and even the half-finished sketch testified to his ability. Compliments were paid him and modestly received. The Frenchman, of course, took the opportunity to make inquiries of Summers and his engineering work, and managed to introduce the subject of wireless. He did not forget to ask whether the unfortunate airship was repaired, and when Charles assured him that everything was O.K. he enthusiastically congratulated the young engineer, adding : " How much I should like to see that beautiful ship sailing again across the sky ! I am very anxious to observe it, you know, for it combines in itself—is it not so ?—the two greatest marvels of this century—the triumph over air and the triumph over space. I know nothing at all about engineering, but I understand enough of the romance of science to wish very much more than I can say to see your great invention, Mr. Summers. When do you sail it again ? —for you know we were promised to see it, and so great is my desire to observe it that I am bold enough to ask you of your generousness to give us the chance that fate did not allow us last year."

Put so pointedly, the request was hard to refuse, and Charles, who was good-natured to a fault, readily replied : " Well, I shall be having it out on Saturday next, Mr. Dupont ; why don't you and your friend come along ? I don't suppose I shall be doing much, but if you care to take the chances, why then perhaps we might be able to amuse you for a short time."

" Oh, thank you, thank you, Mr. Summers," Dupont replied with alacrity. " For myself I can say, without hesitation, I shall be most pleased. As for Beulner, I am not so quite certain, but if my poor word will induce him, why, then he will come *bien volontiers*."

So the meeting was settled on ; but Charles, when he had time to consider it from a remote standpoint, was annoyed with himself for being so easily coaxed into making the suggestion. It was against his own definite self-authorised rules to ask anyone to the manœuvres. Why, then, should he have been so silly as to invite two such bounders as a Frenchman and a German ?—for, with insular prejudice, he always looked upon foreigners as people to be more particularly distrusted and avoided as emissaries of the devil. Well, there was no help for it now ; he couldn't put them off a second time. Nevertheless, he was determined they should see as little as it was possible to show them.

CHAPTER VII.

EN RAPPORT.

The Saturday of the appointment arrived. Quite early in the afternoon the grey car glided up the drive of Sotheby Vicarage and discharged its occupants. The two men had spared no pains to make themselves acceptable, at least in the eyes of their hosts. Well favoured and in the smartest rig that Bond Street could turn out, there was little in their outward appearance to indicate that they were foreigners ; in fact, Beulner might well have passed for an Englishman who had acquired a Continental tone, though Dupont was unmistakably French as soon as you caught

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sight of the long oval-shaped skull and low forehead. They had not long to wait in the drawing-room before Gwen came in from the garden, followed by Mr. and Miss Summers. Introductions were exchanged, and the party in the good old English way immediately wandered over the shady grounds. Small talk passed the time away until tea was announced. Even now Charles did not appear till Miss Summers was urged to make a remark on his dilatory behaviour. Gwen explained that he had a hard problem on hand, and said he could not be interrupted.

"*Mathematique?*" inquired Dupont with airy nonchalance. "If that is so, then he does receive my most sincere condolences. I do hate the *mathematique*. When I was at the University of Paris I used to have to study algebra, euclid, trigonometry, until all my head was one pudding of A, B, C, D, and their sines and cosines. Oh, it was awful. At last I give it up and take to *poèsie* and *la drame*, but perhaps Mr. Summers knows himself in *mathematique*, and do them for the pleasure. Then, if that is so, I quite understand callers are *génants*—in the way—tiresome."

"Oh, no," interposed Miss Summers, "it is not mathematics this time, he could have left those easily enough, but he says he's got to draw up a report for the Government; I don't know exactly what it's about, but I think it's in connection with his wireless station. Anyway, a lot of people have been calling on him lately, and he's been working his little toy airship to death."

"Yes," said Gwen, "I saw some of them in the distance on Thursday. They were driving a splendid new Wolseley car. One of them was stout, and grey-haired, with short grey moustaches."

"Yes, that was a Colonel something or somebody, and such a dear old man. He quite took father's heart. He said he always read the lessons at his parish church, except when it came to the first chapter of Chronicles, which he left, on principle, to the curate!"

"And what's more," chimed in Mr. Summers, "he gave a guinea for the school treat; but that wasn't all profit, for he smoked three of my best cigars."

"Well, he didn't seem to know much about Charles's demonstration. All he said during the gyrations of the airship was, 'Very pretty, very pretty.' At least, that's all I heard him say."

"But I think he had a long conversation with Charles in the conjuring den," Gwen interpolated, "for he stayed there a terrible time. I was sitting on the churchyard wall waiting for him to go, so I know."

At that moment Charles appeared.

"What an age you've been," the three of them shouted in chorus, while Beulner and Dupont rose to shake hands.

"Sorry," remarked the offender, "but I did not think it was so late. I must apologise."

"Yes," chimed in Gwen, "you'll have to be awful nice to make amends. As it is you must be made to suffer for your bad behaviour. There's only one brioche left, and that I buttered for you a long while ago, and there's just half a macaroon which I managed to save. You ought to be very grateful to me, for you don't deserve even that."

Charles was not to be disturbed by this banter. He leisurely seated himself in a deck chair, and munched at the brioche. Meanwhile tea-table talk prevailed.

It centred to a large extent on the strained relations which still existed between Germany and England. Things during the past few months had been going from bad to worse. There was no doubt about it. Germany was trying to get a wider sea coast. She would have liked a port in the Mediterranean, but, finding that impossible, her hopes were set on improving her position in the Baltic. Just a little slice off the coastline of Finland would be of great service to her, and there was no doubt that she had been striving to get possession of the estuaries of the Danube for many years. Now, however, the matter was becoming more urgent. The congestion of German trade made relief not only a necessity, but one of paramount importance. Then, when affairs had assumed the nature of a crisis, a weak Government allowed its foreign policy to be discerned, and the foreign yellow Press was quick to work the matter up into a serious business. It could no longer be overlooked. Questions had been asked in the English Parliament which the Foreign Secretary had found difficult to answer. The lower class Opposition papers

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had not been slow to make the most of this, and soon large columns were devoted to the discussion of England's naval policy, of her equipment in armaments and fleets, and all the branches of modern warfare. The reserve of the Government only made matters worse, and it looked as though a general election was imminent, for it would not be possible much longer to fly in the face of public opinion. Nevertheless, the Government, in spite of their apparent nonchalance, were making eager preparations against any unforeseen circumstance. Their unconcern was more apparent than real. The course they had adopted of trying to throw dust in the eyes of the public, or rather to treat them like children, and pretend that relations between the two countries were entirely amicable, in the hopes that their declaration of faith would be implicitly believed, was only the subterfuge of a weak party. Official circles were fully aware that, without open war, things could not be in a much worse state. Acting on such intimate knowledge, naval authorities were working night and day, in order to be prepared for possible emergencies. The complement of battleships was made up to the last unit. The commissariat was overhauled, and coal was being bought in enormous quantities, so that the supply should be equal to any demand that might be put upon it. Even arrangements were made for calling up the reserve. Similar exertions were being made in the army, and the aerial fleet was no exception to the general rule; but in this instance a somewhat lax War Minister had allowed the newer and less recognised branch of defence to be neglected, or rather, without active negligence, had grudged fostering influence, which alone could enable it to keep pace with the rapid developments of the new science. Now, when things were looked into, it was found that foreign aerial fleets were far in advance of the English, and immediately strenuous efforts were made to rectify the deficiency. The Government workshops were kept busy building new vessels, contracts were placed everywhere for the supply of material necessary, and it was hoped that the official peace would last long enough to allow the vessels to be built. At this opportune moment Summers approached the War Office with regard to his own invention, and the authorities, who at any other time would have been inclined to consider the matter over fantastic, were only too willing to clutch at anything which might save them in an awkward situation. Charles's proposals, therefore, received a readier welcome than would otherwise have been possible, and negotiations had proceeded so well that it looked as though a purchase by the Government would possibly be effected. This Dupont knew, and it was to prevent such a purchase that he had sought this evening's invitation. Armed with such knowledge, he carefully steered clear of any statement or suggestion which might be inclined to rouse Summers's suspicions. He treated the topic in hand as one for amusing comment and scintillating wit, until he had made an opportunity to draw Beulner into the conversation. He compared English soldiery with German, and commented upon the likely methods of either nation in warfare. This led him to the subject of wireless and the object of his visit. He tried to get Charles to talk, but true to his instincts the young Englishman was very reticent. Dupont therefore led Beulner to talk of his experiences with another system, and thus attained his desired result, for Charles quickly became interested, and in some measure threw off his cloak of reserve. Dupont was quick to recognise the change, and when he thought the time was ripe, put one or two leading questions which caused Summers to expostulate and propound his own theories on the subject. In order to corroborate his statements, Charles had resource to his airship, and he was obliged to show his airship to his visitors and explain its superficial mechanism; but when Gwen urged him to give a practical demonstration of his toy, he refused on the ground that it was not in complete working order, and would be damaged, and that it would be risky to attempt such a thing. Later, however, he did give way sufficiently to invite Beulner and Dupont into his den and to explain the Marconi system of wireless to the former, and demonstrate the sending of messages by the ship set. He got into communication with Crookhaven, and allowed the German to use his telephones. What was more, he offered to supervise the fitting up of his station at Hampstead, even

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arranging for inter-communication between them. While the two were so engaged, Dupont attached himself to Gwen, and was shown about the place. Nothing escaped his eye. He saw the mysterious chest with its patent lock, the diagrams scattered here, there and everywhere. Without appearing to glance at the table where Charles had been working, he got an idea of the young man's recent occupation by careful scrutiny of the scribbled papers, carelessly tossed on one side.

He saw, too, the little stationery cabinet standing open on the table, and his fingers itched to help himself to its contents, but he knew such procedure would ruin his chances, and he could find no way of getting what he wanted without showing his hand. Instead, therefore, he kept himself well under control, and talked pleasant nothings to Miss Thrale, until he gathered that Beulner and Summers had completed their discussion. Then he took out his watch, remarking he was sure that they had exceeded the limits of the Vicarage hospitality, and the two of them, after exchanging courtesies with Mr. and Miss Summers, took their leave.

But they did not return to London that night; instead they put up at the Granby Hotel, and told the gratified landlady that they had come down for a quiet week-end.

It was clear that Dupont had much on his mind. All that evening he was buried in tobacco smoke, nor did he go to bed until the frequent attentions of the landlady intimated that she was anxious to shut up for the night. He had a little plan of campaign to work out, but he couldn't quite see his way clear. When he did tumble into bed it was not to sleep, but to lie gazing at the moon as it slowly travelled from one to the other of his bedroom windows. The outcome of his cogitations was a remark to Beulner next morning that he must see the old pedlar woman they had met previously. Beulner made no demur. He accepted the remarks from his chief with a well-trained disinterestedness characteristic of a German officer who has had to submit to years of puppet-like obedience. So it was arranged that they should spend the morning motoring about the country passing and repassing as much as possible, but not too frequently to attract remark, up and down the High Street, round Sotheby Church, and through the lanes where the pedlars had first been seen. Their efforts were rewarded, for about mid-day they came across the old couple sitting in the hedgerow where they had first met them. When the motor-car stopped, and Dupont got out, Suk never attempted to get up, but, with the superciliousness of her sex and class, waited with the passive resistance of a rebel against Society for Dupont to come to her. As Dupont approached her, Suk was the first to speak. "I know'd as how ye were comin' this way, zur. I saw the motor-car outside of the Granby yest' night, and when I heerd yon horn this morning I said to old Doss, they be looking for I, and roight enuf ye may be, for I can tell ye a thing or two. Maister Summers he be doing grert things, an' secret things. There be lots of fine folk nosing round that little shanty, an' there be those that talk in the village an' say as how they be King's men coming to buy the creetur that went sailing over the woods t'other eve. I be sure of this, for I bin making it my business to find oot. More'n that, I been got some rare news that be worth fur more than ten shillin', and I don't see why, if I tell ye, ye shouldna' cross my hand wi' ged geld."

Dupont laughed. The old shrew was a bit of a business woman. He held a sovereign between his thumb and finger. "There, madam, will that do to put in your pocket? But for this I expect fine news, great news. Tell it me."

Suk craned forward and lowered her voice.

"'Tother night, an' it were Friday, aboot five o'clock, when I ha' filled me basket with cresses, and were taking train for Chittingham, a motor driven by Maister Summers and other gentry coom along. They got oot to catch the train for Lunnon, and I crept after them, pretending I wanted th' same train. They were talking aboot the ship thing, for I heerd one of the folk say wireless, and another say, low like, 'I don't see whay the Gove'ment shouldna' buy th' idea as it is.' I dunno' what be th' idea they talked of, but I never let slip a word I could help. Then the govern'r spoke, an' told Summers how that the thing wer urgent, and as how he must git on wid' eet."

(*To be continued.*)

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Colonial Notes

A REPORT presented to the Commonwealth Parliament by Commander Brewis, R.N., on the lighting of the western coast of Australia, reveals the interesting fact that it is more economical to provide these places with wireless telegraph stations than with telephones. Commander Brewis recommends that wherever possible isolated coastal lighthouses that are within reasonable distance of the wireless telegraph stations to be constructed round the Australian coast, or can be connected with one another, should be provided with low-power wireless equipment. In support of his contention that the first cost of the wireless equipment and the cost of upkeep are less than telephones worked by land lines and submarine cables, he mentions that the estimated cost of connecting three lighthouses—Cape Leveque, Cloat's Point, and North-West Cape, all in Western Australia—by telephone with the land lines exceeded £20,000; on the other hand, the cost of providing wireless equipment at twenty of the existing and proposed lighthouses of Australia, where such method of communication is considered desirable, should not exceed a total of £16,000. Commander Brewis, therefore, recommends that wireless telegraphy be installed at the following places:—

Lighthouse.	Nearest Wireless Station.	Distance.
Eclipse Island ..	Albany . .	15 miles
D'Entrecasteux Point	Albany .	110 ,,
Cape Inscription ..	Carnarvon . .	60 ,,
Cloat's Point	Carnarvon	140 ,,
*North-West Cape ..	Cloat's Point Light	70 ,,
Cape Leveque ..	Broome	120 ,,
Lacrosse Island ..	Wyndham	60 ,,

* * *

The example of Australia in this matter might be followed with advantage elsewhere. In Australia it is proposed to entrust the operation of the stations to the lighthouse keepers, nearly all of whom, we understand, are proficient in Morse, and should be able therefore to carry out their wireless duties after a few weeks' training. Great as is the economic advantage that alone is not urged by Commander Brewis in favour of the wireless scheme. There is the valuable aid to safety of navigation in southern waters, where many of the ships possess a wireless installation, as well as to the Commonwealth Meteorologist in compiling and communicating weather reports.

* Cape North-West can be connected by day with a lightship station equipped with low-power wireless telegraphy, but by night will be within easy range of Carnarvon (210 miles) and Roebourne (210 miles).

* * *

That the Canadian Government are convinced of the utility of wireless telegraphy on board vessels engaged in the fishery protection service is evidenced by the equipment of the C.G.S. *Canada* and *Dollard*, which the Marconi Company of Canada have just completed. One of these vessels, the *Canada*, has had an interesting career. She was originally a torpedo-boat destroyer, but was purchased nine years ago by the Dominion Government for fishery protection service in Canadian waters, being stationed at Halifax, N.S. In 1905, the *Canada* was fitted with a coil set of wireless apparatus, but with the advent in 1910 of the *Niobe* and *Rainbow*, which were intended to form the nucleus of a Canadian navy, she was utilised as a training vessel, for which purpose all the available accommodation was required, and it was found necessary to dismantle the apparatus. The vessel has again been commissioned on fishery protection service, this time on the Great Lakes, and bearing in mind the excellent results of the first wireless installation, the Government decided to equip her again. The new apparatus consists of a 1·7 kw. synchronous disc discharger, transmitter and valve receiver, with a coil transmitter and magnetic receiver as emergency gear. Call letters V.D.C. have been allotted to the *Canada*, which is owned and controlled by the Department of the Naval Service. The C.G.S. *Dollard* has just been delivered to the Department of the Naval Service by the Kingston Shipbuilding Company, of Kingston, Ont., where her wireless installation was fitted. Her call letters are V.D.O.

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Educational Notes

THE large number of educational announcements which appear in the advertisement pages of this issue should make a strong appeal to those of our readers who contemplate taking up wireless telegraphy as a career, either as engineers or operators. Within the past two years the number of colleges where the necessary tuition is given has increased considerably.

The school at Marconi House calls for the attention of those resident in London. Here day and evening classes are held; the day class is for students who have generally had some previous land-line or cable telegraphic experience, and serve about two months as learners, in order to acquire a working knowledge of the Marconi system of wireless telegraphy.

Of the institutions which we desire to bring to the notice of our readers, these may be divided into two categories. One of these exists mainly for *teaching*—that is to say, imparting the ordinary routine of instruction in the solid, non-speculative truths underlying the whole fabric of wireless telegraphy. The other class adds to these functions special facilities for the research student. Among the latter, University College (University of London) and the East London College (University of London) hold prominent places. At the famous Gower Street College the Department of Electrical Engineering is under the direction of Professor J. A. Fleming, and it forms part of the faculty of Engineering. The research laboratory is specially equipped with apparatus for the study of high-frequency currents and of wireless telegraphy. At East London College facilities exist for the carrying out of research during the evening as well as in the daytime by duly qualified persons.

The Northampton Polytechnic Institute is well known in London. The full day course in mechanical and electrical engineering subjects will commence on September 29th, and students taking the complete course can specialise in their third and fourth years in wireless telegraphy. At the Working Men's College classes are held in natural and applied sciences specially for beginners,

The prospective operator cannot complain of lack of training colleges. In London the British School of Telegraphy and the London Telegraph Training College are each equipped with standard Marconi apparatus, and prepare students for the examination for the Postmaster-General's certificate. The East London College, which is located in Forest Gate, gives both practical and theoretical instruction. Provincial students are also well catered for. Thus, at the Royal Technical College, Glasgow, a full course of instruction has been arranged, under the direction of Professor Magnus Maclean, for persons desirous of qualifying for the Postmaster-General's certificate in telegraphy as a preliminary to their employment as wireless operators. The two establishments of the Manchester and Liverpool Wireless Telegraph Training Colleges are fitted with Marconi apparatus, and examinations are held frequently at these colleges. The Northern Wireless Schools have also a centre in Manchester, as well as one in Dublin, both of which are equipped with modern apparatus. Leeds, West Hartlepool, and Newcastle-on-Tyne are the headquarters of the Northern Schools of Wireless Telegraphy, and day and evening classes are held at each of these centres.

There are also a number of correspondence colleges with their headquarters in London. The University Engineering College have a course dealing with wireless telegraphy and telephony, and special facilities are offered to those who desire to study for the Postmaster-General's certificate for wireless operators.

The courses of the Empire Correspondence College are adapted to the requirements of operators and engineers and to the examinations of the Postmaster-General.

It is almost superfluous to advise students to learn foreign languages. Hugo's Correspondence Course should be a boon to those who are constantly travelling, or who have not the facilities for obtaining oral lessons.

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Maritime Wireless Telegraphy

ON July 31st an action was brought, before Mr. Justice Bargrave Deane and two of the Elder Brethren of Trinity House, by the owners, master, and crew of the steamship *Devonian*, one of the Leyland liners, to recover salvage remuneration for services rendered to the steamship *Mexico*, her cargo and freight in the North Atlantic, in January and February last.

On January 25th last the *Mexico*, a steamship of 4,885 tons gross, belonging to the Compagnie Générale Transatlantique, left New York on a voyage to Dunkirk with a general cargo. On the 27th a bad south-westerly gale and a very heavy sea was encountered and some of the cargo in the 'tween decks became unstowed and shifted, doing considerable damage, and on the following day the tail-end shaft broke in the stern tube. The *Mexico* at once sent a Marconigram to the agents in New York reporting the accident, and they replied that the *Floride* and *Caroline*, which belong to the defendants' line and are fitted with wireless apparatus, had been sent to her assistance. On January 30th the *Mexico* became unmanageable in an easterly gale and very high sea, in which she rolled heavily. Alarming noises were heard in the holds and showed that the cargo had shifted badly, and at 8 a.m. the operator sent a Marconigram to Sable Island saying "Situation becoming more critical." About the same time the *Devonian*, bound from Boston to Liverpool with passengers and a general cargo and manned by a crew of 87 hands, received the following call from the *Mexico*: "Adrift with propeller lost, position 39.50 N., 59.33 W.; we expect help from steamers *Caroline* and *Floride*, both coming; please let them know our position." Further messages were exchanged, and when it was ascertained that the *Devonian* could reach the *Mexico* inside of eight hours she was requested to approach for fear of worse weather. The *Devonian* accordingly altered her course, and eventually the *Mexico* was sighted about 10.30 p.m. and the *Devonian* was requested to stand by till daylight. On the following morning the master of the *Devonian* sent a message that he could not wait indefinitely, and as no message had been received from the *Floride* or *Caroline* the master of the *Mexico* accepted the offer of the *Devonian* to tow her to Halifax. By means of a line brought by the lifeboat of the *Devonian* two of her wire hawsers were hauled on board the *Mexico* and made fast. The weather had then moderated. About 10 a.m. on January 31st the towage began. The vessels were then about 390 miles from Halifax. Shortly afterwards the vessels received a message from the *Floride* that she was 140 miles distant, but as the *Devonian* was doing the towage, the *Floride* resumed her voyage under instructions from New York. On February 1st and 2nd the weather was very bad again, and the *Devonian* hove to and just kept her engines working sufficiently to keep the hawser taut. During the afternoon of the 3rd the weather moderated and the towage towards Halifax was resumed, and was continued without particular incident till the afternoon of the 4th, when the *Mexico* was safely brought to an anchorage in Halifax.

The value of the *Devonian*, her cargo and freight was £252,177. The *Mexico* and her cargo were valued at £77,755, and there was no freight at risk.

The Court awarded £7,326 17s.

Mr. Justice Deane, in his judgment, said that the weather was not very bad the day the towage began, but in the night the weather altered, and the sea got up and the conditions were entirely changed. The *Mexico* rolled very violently and made very bad weather of it, her steering got worse, and she had a considerable list—12 or 15 degrees—to starboard, and that made her rolling worse, as the ship kept coming to port in spite of helm fully starboard. About 9.30 a.m. on February 1st, when the weather had got worse, the *Mexico* sent this message: "Rolling becomes dangerous. Please bring to sea a little more." The captain of the *Devonian* replied: "I notice your terrible rolling, but do not dare to go any faster to keep more head to sea fearing I part hawser." Later, the master of the *Mexico* called the

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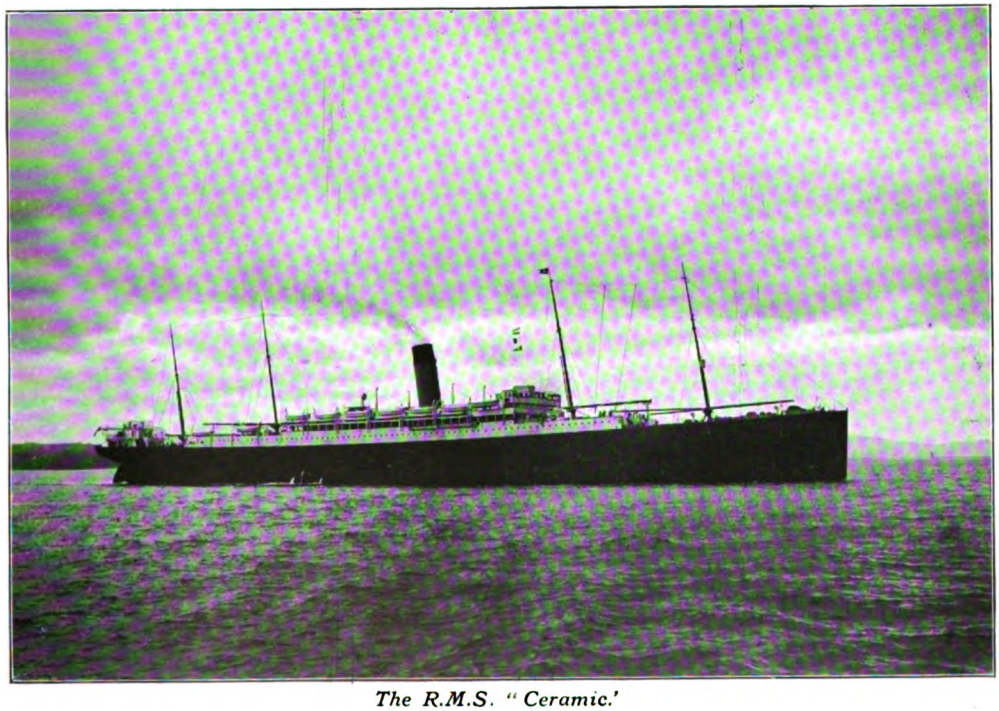
Devonian asking what weather to expect, as he was "fearing for the night." On the night of February 1st the weather became still worse, and in the morning the *Mexico* sent this message: "How has the night been, here very bad with incredible rolling, we don't lose confidence for we trust in your hawser, hope better weather for the day." There could be no doubt that the towage was then extremely dangerous. The cargo in the *Mexico* was loose, and that increased the list, and his Lordship was advised by the Elder Brethren that if this vessel had not been in tow she would probably have got into the trough of the sea and capsized, and not only the ship but valuable lives would have been lost. On February 3rd the same conditions prevailed, and the *Mexico* steered very wildly. Subsequently the weather got better, but the vessels were troubled with snow flurries, and, added to these troubles, the master of the *Mexico* was not sure that his reckonings were right. However, the vessels arrived safely at Halifax on the afternoon of February 4th. There was no doubt that it was a very valuable service extremely well performed, and that there was considerable danger not only to the salved ship but also to the salvors; to save property worth £77,700, property valued at £252,000 was put in jeopardy, so that a great responsibility rested on the master of the *Devonian*. The towage lasted 4½ days, and the *Devonian* lost 7½ days in consequence of the services. It was difficult to conceive a better service, and the award his Lordship would make was the sum of £7,000—£4,600 to the owners, £500 to the master, and £1,900 to the crew. In addition, he allowed £326 17s. for expenses at Halifax and loss of ropes and gear.

This case is a striking instance of the value of wireless telegraphy to ships at sea.

* * *

The new Cunard Canadian liner *Andania*, which has recently returned from her maiden voyage, is the latest example of the one-class cabin—called second cabin—type of steamer. The *Andania* is a twin-screw vessel of 13,400 tons, her length being 540 ft. and her breadth 64 ft. The ship is fitted with the Marconi wireless apparatus, and the system of submarine signalling is also incorporated in the design. The *Andania* has accommodation for 2,140 passengers—520 cabin and 1,620 third class.



The R.M.S. "Ceramic."

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Contract News

The Marconi Wireless Telegraph Company of America notify that the following vessels have been equipped with Marconi Apparatus during the past month.

Ship.	Owners.	Call Letters.	Apparatus.	Remarks.
S.Y. *Cyprus*	D. C. Jackling	KYD	5 kw. and emergency	Private yacht.
Comet	Standard Oil Co.	KJT	2 kw. and emergency	Engaged in oil transport.
Senator Bailey	Steele Towing and Wrecking Co.	KGS	,,	—
S.Y. *Emeline*	Robt. Graves	KYN	,,	Private yacht.
Illinos	Texas Steamship Co.	KTH	,,	Transport vessels carrying limited number of passengers.
Lyra	Luckenbach Steamship Co.	WNG	,,	
S.Y. *Wana*	G. C. Sherman	KYX	1½ kw. and emergency	Private yacht.
S.Y. *Wakiva*	Edw. L. Doheny	KYI	,,	Private yacht.
Merced	McCormick Co.	WSZ	,,	—
Chicago	U.S. Government	NDI	,,	
Gloucester	,, ,,	NGI	,,	
Marblehead	,, ,,	NJO	,,	
Dorethea	,, ,,	NES	,,	These vessels belong to the United States Naval Militia. The contract for their equipment provides for service *via* the coast station of the Marconi Wireless Company of America.
Don Juan de Austria	,, ,,	NER	,,	
Gopher	,, ,,	NGK	,,	
Machias	,, ,,	NJI	,,	
Vixen	,, ,,	NVS	,,	
Wolverine	,, ,,	NWN	,,	
Essex	,, ,,	NFJ	,,	
Dubuque	,, ,,	NEU	,,	
Yantic	,, ,,	NXC	,,	
Maine	,, ,,	BQK	,,	Hospital ship in the service of the Government.
Petroleum	,, ,,	BQM	,,	Petroleum carrier in the service of the Government.
Radiant	Standard Oil Co.	KTR	1 kw. and emergency	Engaged in oil transport.
Brilliant	,, ,,	KTI	,,	
Forward	Yankee Salvage Co.	KPF	,,	—
Vessel not yet named	Chicago Duluth and Georgian Bay Trans	WEN	,,	
State of Ohio	Cleveland and Buffalo Trans. Co.	WFR	,,	Engaged in world-wide Service.
See and Bee	,, ,, ,,	WFS	,,	
Lakeland	Port Huron and Duluth Steamship Co.	WDL	,,	
S.Y. *Lydonia*	W. A. Lydon	WDY	,,	Private yacht.

The following vessels have been equipped by the Debeg Company.

Ship.	Owners.	Call Letters.	Remarks.
Gelria	Koninklijke Hollandsche Lloyd	—	
Tubantia	,, ,, ,,	—	—
Insulande	Rotterdamsche Lloyd	—	—
Guardian	Central and South American Telegraph Co. of New York	WGZ	Cable ship.
Imperator	Hamburg Amerikanische Packetfahrt A.G.	DIT	
Antonia	,, ,, ,, ,,	DAN	
Armenia	,, ,, ,, ,,	DEM	Passenger vessels.
Belgia	,, ,, ,, ,,	DBY	
Bosnia	,, ,, ,, ,,	DBZ	

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Orders have been received during the past month by the Marconi International Marine Communication Co. to equip or to refit the following Vessels :—

Ship.	Owner.	Apparatus.	Remarks.
Canning	Lamport and Holt	1½ kw. and emergency	Sailing between Liverpool and South America.
Berbice	Royal Mail Steam Packet Co.	,,	—
Bealantia	,, ,, ,,	,,	—
Mediator	The Admiralty	,,	—
Ingoma	F. and T. Harrison, Ltd ..	,,	Liverpool to the Cape.
—	Hellyers Steam Fishing Co. ..	½ kw. and emergency	Three units of important fishing fleet.
—	,, .. ,, ..	3 kw. and emergency	The Carrier attached to the Fleet.

Vessels which have been or are being equipped with Marconi apparatus since our last issue.

Ship.	Owners.	Apparatus.
Caribbean	Royal Mail Steam Packet Co.	1½ kw. and emergency.
Kaipara	New Zealand Shipping Co.	,, ,,
Morinda	Burns, Philp & Co.	,, ,,
Baroda	British India Steam Navigation Co.	,, ,,
Vedamore	Johnson Line	,, ,,
Toronto	Wilson Line	,, ,,
Malaspina	Canadian Government	,, ,,
Soudan	P. & O. Line, Chartered as Troopship	,, ,,
Conqueror	His Grace the Duke of Manchester	½ kw. and emergency.
Iroquois	Anglo-American Oil Co., Ltd.	,, ,,
Navahoe	Anglo-American Oil Co., Ltd	,, ,,
City of Delhi	Hall & City Lines	,, ,,
City of Chester		.. ..
City of Colombo		.. ,,
Kazembe	Bucknall Steamship Lines, Ltd.	,, ..
St. George	Canadian Pacific Railway	,, ,,

The Spanish and General Wireless Trust

MR. GODFREY C. ISAACS, presiding at the meeting of the Spanish and General Wireless Trust, on August 1st, said that their assets were almost entirely composed of shares in the Compañia Nacional de Telegrafia Sin Hilos, the progress of which had not been sufficiently rapid to produce any revenue to this company in the shape of a dividend. Under the terms of the concession from the Spanish Government, a number of stations had been constructed, the first of which were at Aranjuez, near Madrid, Barcelona, Soller, in the Balearic Islands, Cadiz, Vigo, and Las Palmas and Teneriffe, in the Canary Islands. The business had so far been mainly that of communication with ships at sea, the receipts of which had not come up to expectations. However, there had already been a marked improvement in the stations' receipts, and the number of messages was increasing month by month, and likewise the installations on board ships. The Portuguese Parliament had recently passed a law rendering wireless telegraphy obligatory on board all vessels of a certain denomination, and, no doubt, similar legislation would follow at an early date in Spain, which should add considerably to the business of the coast stations. During the year a new station had been opened at Santander, and others were approaching completion. Considerable difficulty seemed to have been encountered with the telegraph authorities in Madrid, which had given the directors of the Compañia Nacional a great deal of trouble in connection with the international telegraph service. Under the terms of the concession the company was clearly entitled to conduct that service, but this was questioned by the authorities. The board were advised, however, that the matter had now been practically settled, and negotiations had been opened by the Spanish Minister of Posts and Telegraphs with foreign postal administrations with a view to making the necessary arrangements for a wireless service. It was hoped that before long such a service would be in operation between Spain and this country, a station on each side being ready to start such a service from the moment the necessary authority on this side could be obtained. Other telegraphic developments had been retarded owing to the wars in Tripoli and Morocco.

The report was adopted without discussion.

The annual report of the Directors of Marconi's Wireless Telegraph Co. appears on page 388.

The Share Market

LONDON: *August 18th*, 1913.

The appearance of the Industrial Share market is more favourable than for some time past, the chief feature being the marked advance in prices in the shares of the various Marconi issues following the publication of the report.

A decided revival of public interest has taken place in the shares, the earnings now shown being in accordance with the highest anticipations.

The prices as we go to press are: Ordinary, 4¼; Preference, 3⅝; Canadas, 14/-; Spanish, 13/-; American, $1\frac{3}{16}$.

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Marconi's Wireless Telegraph Co., Limited

REPORT OF THE DIRECTORS AND STATEMENT OF ACCOUNTS

For the year ending December 31st, 1912

Presented at the Annual Ordinary General Meeting of the Company, held at the Whitehall Rooms, Hotel Metropole, Whitehall Place, London, S.W., on Friday, August 22nd, 1913

CAPITAL - - - - - - £1,000,000

Divided into 250,000 Seven per Cent. Cumulative Participating Preference Shares of £1 each and 750,000 Ordinary Shares of £1 each

DIRECTORS.

COMMENDATORE G. MARCONI, LL.D., D.Sc., Chairman.
GODFREY C. ISAACS, Esq., Managing Director.
SAMUEL GEOGHEGAN, Esq.
ALFONSO MARCONI, Esq.
MAJOR S. FLOOD PAGE.
CAPTAIN H. RIALL SANKEY.
HENRY S. SAUNDERS, Esq.
COLONEL ALBERT THYS.
M. MAURICE TRAVAILLEUR.

AUDITORS.
COOPER BROTHERS AND COMPANY.

SOLICITORS.
COWARD AND HAWKSLEY, SONS AND CHANCE.

SECRETARY AND OFFICES.
HENRY W. ALLEN, F.C.I.S., MARCONI HOUSE, STRAND, LONDON, W.C.

Report of Directors.

The Directors herewith submit the Balance Sheet together with Profit and Loss Account for the year ending December 31st, 1912.

As it was not found possible to complete the audit until comparatively recently, your Directors thought it desirable and felt warranted in deferring a little the submission of their report, they having entered into a new contract with His Majesty's Postmaster-General and considered it desirable to await its ratification by Parliament.

In the report for the year 1911 it was stated that the Share Premium Account would be increased in the next Balance Sheet to the sum of £256,630 5s. 2d. It will be observed from the Balance Sheet now presented that this figure stands at £255,707 3s. 1d. The difference is accounted for by the expenses in connection with the issue, amounting to £923 2s. 1d., having been debited to this account.

During the year 1912 the business of the Company continued to make satisfactory progress, the gross profit having amounted to £537,243 4s. 11d., as compared with a sum of £214,407 1s. 4d. for the preceding year, and a net profit is carried to the Balance Sheet of £413,294 11s., as compared with £141,717 7s. 1d. for the year 1911. A part of the above profit having been derived from the realisation of shares, your Directors deem it prudent to take this opportunity of creating a reserve account, and have appropriated £100,000 for this purpose.

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The Directors recommend the payment of a final dividend for the year 1912 of 10 per cent. on both classes of shares.

Summarised, the proposed appropriation of the available balance is as follows:

Preference Shares: Dividend of 17 per cent. for year ended December 31st, 1912, of which 7 per cent. was paid on August 1st, 1912	£42,500	0	0
Ordinary Shares: Dividend of 20 per cent. for year ended December 31st, 1912, of which 10 per cent. was paid on August 1st, 1912, on the amounts paid up on July 8th, 1912	149,920	17	9
General Reserve Account	100,000	0	0
Balance carried forward to next account...	146,726	5	11
	£439,147	3	8

Your Directors propose to declare at the General Meeting a dividend at the rate of 7 per cent. for the year 1913 on the Preference Shares.

In the Balance Sheet, Patents and Shares in Associated Companies are again taken into account at their cost price, with the exception of the Spanish Shares and a portion of the American Shares, which figure at their par value. The Directors desire to draw the attention of shareholders to these words, for, notwithstanding that the same statement was made in the Directors' Report for the year 1911, misunderstanding arose in the minds of some, in consequence of its having been stated by some that the profits appearing in the Balance Sheet had been arrived at by means of writing up the shares held in Associated Companies. In order that there shall not be any misunderstanding of this nature in the future your Directors desire to make it clear that, whenever shares are acquired by the Company they figure in the margin of the Balance Sheet at their par value, and, no matter what that total may represent, they are taken into account in the Balance Sheet only at their actual cost price to the Company. To this figure is added the cost of patent renewals, patent applications, and any sum which may be paid in acquiring or protecting patents. Thus, in the Balance Sheet now submitted the £856,119 8s. 4d. represents the cost to the Company of the whole of its Patents and Shares in Associated Companies, the latter being represented in the margin at their par value of a total of £1,594,583 12s. 3d. Whenever the Company sells any portion of its share holding the Share and Patent Account is credited with the average or actual cost price of the shares, including a proportion of the cost of patents as stated above.

The total cost of shares and patents shows an increase over the figures of the preceding year of £347,596 0s. 4d. This is accounted for largely by the addition of shares in the American Company, which were acquired at par.

The total par value of shares shows a decrease as compared with the preceding year of £480,139 19s. 6d. This arises principally in consequence of the readjustment of the capital of the Argentine Company. The Argentine Directors considered that the capital of the Company, which was formed in the year 1906, with a capital of $6,750,000, of which $6,000,000 was in "A" Shares of $5 each and $750,000 in "B" Shares of $5 each, was excessive, and this Company has consented to the cancellation of 200,000 "A" Shares, of which our proportion was 155,898, and that one new "AA" Share should be exchanged for four shares of the original capital. It has also been agreed that the "B" Shares, of which this Company holds 78,250 of a total of 150,000, and which rank preferentially as regards capital, shall receive a preferential dividend of 5 per cent. and an increased proportion of any remaining profits.

By these arrangements this Company's holding in the Argentine Company shows a nominal decrease in the par value of its "AA" Shares of £676,780 15s. and an increase in the value of its "BB" Shares of £5,325, paid in respect of calls on these shares. This Company's interest in the Argentine Company is, therefore, practically unchanged; the alteration affects the number of shares and their nominal value only.

With the development of the wireless industry throughout the world the business of the Associated Companies in which this Company is interested is extending considerably.

BELGIAN COMPANY (Compagnie de Télégraphie sans Fil).—The business of this Company has continued to increase and show very satisfactory profits. It has recently been reorganised and its capital increased to £90,000, of which this Company holds one-third.

FRENCH COMPANY (Compagnie Française Maritime et Coloniale de Télégraphie sans Fil).—This Company has declared a dividend for the year 1912 of 10 per cent. on the Ordinary Shares and 31·25 francs per share on the Founders' Shares.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, LIMITED.—The business of this Company during the year 1912 showed an increase of over 60 per cent. in its receipts, and a dividend of 10 per cent. was declared, an increase of 3 per cent. over that of the preceding year. This Company's business continues to develop in a very satisfactory manner.

GERMAN COMPANY (Deutsche Betriebsgesellschaft für Drahtlose Telegraphie m.b.H.) (Debeg).—This Company has paid a dividend of 8 per cent. for the year ending September 30th, 1912.

RUSSIAN COMPANY (Société Russe de Télégraphes et Téléphones sans Fil).—This Company has declared a dividend for the past year at the rate of 6 per cent. Its business continues to show very satisfactory development, and the business in hand this year represents a very substantial increase over that of the preceding year.

THE MARCONI WIRELESS TELEGRAPH COMPANY OF CANADA, LIMITED.—Under their contract with the Canadian Government for the operation of wireless telegraph stations on the Great Lakes, four stations have been established and placed in operation during the past year. One station is at present being enlarged and three other stations are to be built during the current year.

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The negotiations with the Newfoundland Government were brought to a satisfactory termination in December by the completion of a contract which will continue the Company's exclusive rights in Newfoundland until the year 1926.

Under agreements with the Canadian and Newfoundland Governments the Company operates 32 stations in Eastern Canada and Newfoundland and five stations on the Great Lakes.

The Company also carries on a public telegraph service on forty-four steamers.

The Canadian Government has passed a law making wireless equipment of passenger vessels compulsory, which will necessarily result in further business for the Company.

The Company has now in hand for the Department of Railways the construction of two high-power stations at Hudson Bay and Le Pas, Manitoba, in connection with the construction of the new Hudson Bay Railroad by the Canadian Government.

Under their agreements with the Canadian and Newfoundland Governments the Canadian Company's subsidies from these Governments now exceed $100,000 per annum.

SPANISH COMPANY (Compañia Nacional de Telegrafia sin Hilos).—Seven of the first group of stations in Spain and the Canary Islands are in operation. The construction of the stations of the second group has been commenced, the first of which has been completed and opened to service.

During the breakdown of the cable between the Canary Islands and Spain the telegraph service was satisfactorily conducted by the Marconi stations. Arrangements are being made for this service to be opened permanently in the course of the next few weeks. Negotiations are pending for wireless telegraph services to be opened with this country and with Italy. The Company has obtained orders from the Spanish Government for military stations, and also secured the whole of the orders placed by the Minister of Marine during the last year for the equipment of ships of the Spanish Navy.

ARGENTINE COMPANY (Cia Marconi de Telegrafia sin Hilos del Rio de la Plata).—Besides the change in the capital of the Company, to which reference has already been made, there has been an alteration in the Directorate and Management. Upon the occasion of the visit of the Company's Representative to Buenos Ayres last year it was found that the Government Concession for the erection of a high-power station for external telegraph service was not in a satisfactory form. Subsequent negotiations, however, resulted in a new arrangement being entered into with the Government and the construction of a high-power station has now been commenced. A similar station will be erected in this country, and when completed a direct wireless telegraph service between the Argentine and Europe will be opened.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.—This Company has declared a dividend of 2 per cent. for the year ending January 31st, 1913, a satisfactory result, having regard to the fact that the contract with the United Wireless Telegraph Company did not come into force until the month of July of last year, and called for considerable negotiation with shipowners and others to bring about more satisfactory terms upon which the work was in future to be conducted. The full benefit of these improved working conditions was therefore only enjoyed for a comparatively short period of the year. It will also be borne in mind that the increase of capital to the extent of £1,400,000 was for the purpose of providing a network of long-distance telegraph stations and the creation of telegraph services. Time is necessarily required to construct these stations, but this work has proceeded with all possible expedition. It is contemplated that before the end of this year a rapid and reliable telegraph service will be opened between this country and New York. Arrangements will be made to open collecting stations in the City of London and in each of the principal towns in England and Scotland. Similar arrangements have been made in the United States. It is expected that a substantial revenue will accrue from this source.

Stations are in course of construction at San Francisco and the Hawaiian Islands, which are approaching completion. It is hoped that before the end of the year we shall see a wireless telegraph service in operation between the United States and Japan, which will then be extended to the Philippine Islands and China.

The contract with the Norwegian Government having been ratified by the Norwegian Storthing, a further Transatlantic Station will be erected immediately to conduct a telegraph service direct with the North of Europe. Under the terms of the agreement the Norwegian Government will send all telegrams handed in at the telegraph offices for the United States by wireless unless specially routed otherwise by the sender. The Company and the Norwegian Government will pool the receipts of their respective stations, which should add a substantial source of revenue to the American Company.

Important negotiations are in progress with South American States, which should result in the construction of additional stations in the United States in the early future, and open up direct wireless telegraph service between North and South America.

At all of the stations under construction the new duplex system is being installed, which will provide for a service to be conducted in both directions at the same time. Automatic sending and receiving apparatus is also being supplied, which will enable messages to be transmitted at a speed up to about 100 words per minute in each direction, and this rate of working is likely to be exceeded.

FIELD STATION DEPARTMENT.—During the past year very considerable progress has been made both in the design and sale of portable wireless telegraph stations for military purposes.

Important improvements have been made in the Company's apparatus, and to meet the demands of the armies of the world the Company has added the following to its standard types of stations:

1. A 3-kilowatt station for transport by cart or motor-car.
2. A 1½-kilowatt station for transport by horses or camels.
3. A ½-kilowatt cabinet station for use as a permanent station where space is limited.

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Highly satisfactory demonstrations of our field stations were carried out during the past year in several countries, from which a large business is expected to result.

Important orders have been received for field station apparatus from the British War Office and the Italian, Turkish, Roumanian, Greek and Servian Governments, and the total sales of this class of apparatus have nearly quadrupled in the past year, and continue to show substantial increase. The Company have made such arrangements as will enable it to give immediate deliveries of all classes of field stations, for which a big demand arises unexpectedly, and prompt deliveries are of all importance.

GENERAL BUSINESS.—During the past year this Company and its subsidiaries have received contracts and executed work for the Governments of the following countries: Great Britain, Canada, Newfoundland, India, South Africa, Ceylon, Falkland Islands, Trinidad, Italy, Russia, Turkey, Spain, Portugal, Norway, Roumania, Servia, Greece, Montenegro, United States of America, Brazil, Chile, Bolivia, Colombia, Japan and China.

Shareholders have been advised that, owing to the delay in submitting to Parliament for ratification the contract entered into with His Majesty's Postmaster-General for the construction of the Imperial Stations, and the substantial rise in the cost of materials, your Directors gave notice that they no longer considered that contract binding upon them. A new contract has been entered into in which provision is made for any extra cost which may be incurred by reason of the delay in the construction of the stations, and certain alterations and additions have been agreed to. Your Directors do not believe that the altered conditions will prove of any disadvantage to the Company, and, having regard to the position which the Company holds in the wireless industry, and which position your Directors are confident the Company will continue to hold, they contemplate that they will construct all the stations required for the Imperial Chain.

For a long-distance wireless telegraph service a number of the Company's recent patents play an essential part, and during the last twelve months your Scientific Adviser, Mr. Guglielmo Marconi, has applied for patents for a number of important inventions and improvements for apparatus used in both transmitting and receiving stations.

Notwithstanding all that has been stated and published in recent times respecting the continuous wave system of wireless telegraphy, experience has not yet proved that that system will be capable of conducting a long-distance wireless telegraph service as efficiently as the slightly damped spark system at present in use. Mr. Marconi has invented what your Directors believe to be the simplest and most economical method of generating, transmitting, and receiving continuous waves, and he alone has been able to transmit messages across the Atlantic by a continuous wave system, of which a satisfactory demonstration, and the only one, was given to the Advisory Committee appointed by the Government. Further tests are being conducted, but considerable work and time are required before it will be possible to say with any degree of assurance that any advantage in practical working is to be obtained, either by the continuous wave system alone, or used in conjunction with the spark system.

With the ability of the large staff of engineers employed by this Company, together with their valuable experience, directed and assisted by Mr. Marconi, your Directors are confident that the development of the wireless industry will continue to be pioneered by this Company.

The high-power station which is being constructed in Carnarvon, and which will be worked by the Company to conduct a direct service with New York, it is anticipated, will be completed and opened for service during the present year. It is being supplied with both the spark and continuous wave systems, which alone will prove from actual experience the comparative merits of the slightly damped wave and the continuous wave in all weathers, under all conditions, every day, week, and month of the year.

Important negotiations are being conducted with several foreign Governments for the erection of long-distance stations, which it is hoped will be brought to a successful issue at an early date.

The successful arrangements made in April, 1912, for placing share capital of the American Company have recently been made the subject of legal proceedings by Mr. O. Locker-Lampson, M.P., and Mr. P. E. Wright against the Company, your Directors and other persons. Within the last few months and shortly before the issue of the Writ these gentlemen acquired two and one shares respectively of this Company. Mr. Locker-Lampson has since increased his holding by 20 shares. No relief is claimed against the Company, which is merely joined as a nominal defendant. The apparent object of the proceedings is to impeach the action of the Directors and other persons in connection with the above arrangements.

The Writ was issued so long ago as May 23rd last, but at present Mr. Locker-Lampson and Mr. Wright have not delivered their claim.

Beyond this passing reference your Directors are advised that it would not be proper for them at this stage to make further comment or explanation.

The action for the infringement of patents against the National Electric Signalling Company was heard in New York during the month of June last, in connection with which Mr. Guglielmo Marconi gave lengthy evidence. The Court has not yet delivered its judgment.

The Directors retiring by rotation are Commendatore G. Marconi, LL.D., D.Sc., Mr. Alfonso Marconi, and Capt. H. Riall Sankey, who, being eligible, offer themselves for re-election.

The auditors, Messrs. Cooper Brothers & Co., also retire, and offer themselves for re-appointment.

By Order of the Board,

Marconi House, Strand, London, W.C.
August 11th, 1913.

HENRY W. ALLEN, *Secretary.*

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Dr. BALANCE SHEET,

	£ s. d.	£ s. d.
To Capital—		
Authorised—Issued and fully paid.		
750,000 Ordinary Shares of £1 each...	750,000 0 0	
250,000 7 per Cent. Cumulative Participating Preference Shares of £1 each	250,000 0 0	
		1,000,000 0 0
„ Share Premium Account		255,707 3 1
„ Bills Payable		15,286 3 3
„ Sundry Creditors		236,843 13 3
„ Reserve for Expenses Unpaid and Payments in Advance		19,572 14 5
„ Profit and Loss Account—		
Balance as per last account, December 31st, 1911	160,756 6 3	
Deduct Preference Dividends and Ordinary Dividends for 1911 ...	134,903 13 7	
	25,852 12 8	
Profit for the year as per Account	413,294 11 0	
	439,147 3 8	
Deduct—		
7 per cent. Dividend on Preference Shares paid August 1st, 1912 ... ... £17,500 0 0		
10 per cent. Interim Dividend on Ordinary Shares paid August 1st, 1912 ... ... 74,920 17 9		
	92,420 17 9	
		346,726 5 11
To Contingent Liability on Shares in Associated Companies £51,062 10 0		
		£1,874,135 19 11

Dr. PROFIT AND LOSS ACCOUNT for

	£ s. d.
To Rents, Rates, Taxes, Travelling and General Expenses and Income Tax	24,944 4 11
„ Salaries and Directors' Remuneration	58,603 10 6
„ Law Charges and Patent Expenses	5,588 8 3
„ Depreciation of Plant, Machinery, Buildings and Furniture	14,697 11 3
„ Foreign Agencies Expenses	3,268 7 11
„ Station Expenses and Experimental Work	19,621 14 1
„ Balance being Profit for the year carried to Balance Sheet	413,294 11 0
	£540,018 7 11

Report of the Auditors

We have audited the above Balance Sheet. The item, Patents and Shares in Associated Companies, in Montreal, New York, Buenos Ayres, Madrid and St. Petersburg, and shares for which certificates have Company. We have obtained all the information and explanations we have required. In our opinion affairs according to the best of our information and the explanations given to us, and as shown by the

LONDON, *August 11th*, 1913.

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December 31st, 1912. Cr.

	£ s. d.	£ s. d.
By Cash at Bankers, in Hand and on Loan at Short Notice		278,320 19 7
„ Sundry Debtors and Debit Balances		381,418 18 10
„ Stock at Cost or Under as certified by Officers of the Company ...		81,206 14 8
„ Freehold Works at Dalston	39,160 15 4	
Deduct Mortgage	15,611 12 4	
		23,549 3 0
„ Freehold Property at Chelmsford and Plant, Machinery and Buildings at Chelmsford and Genoa Works		95,354 16 7
„ Long Distance Freehold Stations at Clifden, Ireland, Poldhu, Cornwall, and Carnarvon, Wales, and Movable Plant at other places ...		143,504 5 10
„ Office Furniture and Fittings at Head Office, Chelmsford, and Foreign Agencies		14,661 13 1
„ Patents and Shares in Associated Companies—		
198,790 fully-paid shares of £1 each of the Marconi International Marine Communication Co., Ltd.	198,790 0 0	
157,740 fully-paid shares of $5 each Series "AA" of Compañia Marconi de Telegrafia sin hilos del Rio de la Plata (Argentine Company)	157,740 5 0	
78,250 shares of $5 each (35 per cent. paid) Series "BB" of Compañia Marconi de Telegrafia sin hilos del Rio de la Plata (Argentine Company)	27,387 10 0	
566,826 fully-paid shares of $5 each of the Marconi Wireless Telegraph Company of America	566,826 0 0	
414,855 fully-paid shares of $5 each of the Marconi Wireless Telegraph Company of Canada, Ltd.	414,855 0 0	
250 shares of £1 each (20 per cent. paid) of the Marconi Press Agency, Ltd.	50 0 0	
240 fully-paid Preference Shares of Pesetas 500 each of Compañia Nacional de Telegrafia sin hilos (Spanish Company)	4,444 8 10	856,119 8 4
100,750 fully-paid shares of £1 each of the Spanish and General Wireless Trust, Ltd.	100,750 0 0	
11,500 fully-paid shares of Roubles 100 each of Société Russe de Télégraphes et Téléphones sans Fil	122,340 8 5	
175 fully-paid Ordinary Shares of Francs 100 each of Compagnie Française Maritime et Coloniale de Telegraphie sans Fil	700 0 0	
90 Parts Bénéficiaires (Shares) of no capital denomination of Compagnie Française Maritime et Coloniale de Télégraphie sans Fil	700 0 0	
100 Founders' Shares of no capital denomination of Compagnie de Télégraphie sans Fil (Belgian Company) ...	700 0 0	
Sundry shares	700 0 0	
Total Par Value	£1,594,583 12 3	
		£1,874,135 19 11

the Year ending December 31st, 1912. Cr.

	£ s. d.
By Balance of Contracts, Sales and Trading Account	537,243 4 11
„ Transfer and Share Warrant Fees	2,775 3 0
	£540,018 7 11

to the Shareholders.

G. MARCONI, *Director.*
H. RIALL SANKEY, *Director.*

as to which see Directors' Report, includes shares of the par value of £951,699 5s. 11d., which are deposited not been issued. We have seen letters stating that the shares deposited abroad are held on behalf of this such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Company's books of the Company.

COOPER BROTHERS & Co. *Auditors.*
Chartered Accountants.

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INSTRUCTION IN WIRELESS TELEGRAPHY

The Wireless Transmitter

(*Fifth Article.*)

The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appeared in the August number, page 337.]

ERRATA.—*Before proceeding further, we have to refer to some errors in the reference letters and numbers relating to the diagrams in our July and August articles, due to the fact that two sets of diagrams had been prepared. We specify the various errata below.*

July number.—*Fig.* 5, *referred to in the second column of p.* 262, *does not appear at all, its place being taken by Fig.* 7, *which shows the aerial connected directly to earth, the spark-gap mentioned in the text being omitted. In the first column of p.* 263 *the words "such as those shown in Figs.* 6 *and* 7 *" should read "such as those shown in Figs.* 5 *and* 6."

August number.—*In the description of Fig.* 9, *top of second column, p.* 336, *for A write J, for B write C, for C write D, for D write S.*

In the description of Fig. 10, *middle of same column, for A write J, for B write A, for C write E, for D write S.*

In the description of Fig. 11, *page* 337, *for B write E, for C write S, for D write J, for E write P, for H write B.*

In the heading of paragraph 32, *page* 335, *write "circuit" for "current." The heading will then read: Application of a High Voltage to an Oscillating Circuit.*

33. WE saw in our August article how a closed circuit could be set oscillating, by charging up a condenser to a high voltage by means of an induction coil and allowing it to discharge through an air-gap. Referring to Fig. 9 of that article, we see that the right-hand part of the diagram is drawn in thick lines. This is a convenient way of denoting the *oscillating* portion of the circuit, and as—especially in complicated diagrams—it is of great importance to distinguish between the oscillating circuits and the "low-frequency" circuits such as the induction-coil windings and leads, the reader is advised to follow this plan throughout. Looking at this Fig. 9, it may be asked, how can the thick lines be said to form a "circuit" at all since there is a distinct gap—S? A little thought will shows us that the gap is only a break in the circuit while the condenser is being charged up by the coil, during which time there are no oscillations and the circuit is not oscillatory; but when the voltage of the condenser has reached the value necessary to break down the insulation of the air between the spark-balls a spark takes place, and, as we said on p. 336, the gap then becomes a conductor, and the circuit is truly a closed one; it is during this time that the oscillations take place, so that the circuit is completed and forms a "closed oscillatory circuit." Similarly, in the next diagram, Fig. 10, when the spark takes place the circuit is completed and forms an "open oscillatory circuit."

34. **Factors limiting the power of Oscillating Circuits.**—We have also seen that the power which can be stored up in such a circuit depends on the capacity of the condenser, on the voltage to which this is charged, and on the number of times per second that it is charged and discharged. The last of these factors is limited by the following considerations. The note produced in the telephones of the receiving station has the same frequency as the frequency of the spark at the transmitting station, and the human ear cannot hear a note whose frequency exceeds a certain value, between 10,000 and 20,000

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per second. Before this limit is reached, however, another practical difficulty arises, when the spark is produced by an induction coil, inasmuch as the construction and adjustment of a contact breaker to work at even a tenth of such a frequency becomes practically impossible.

If, therefore, we have an unlimited supply of power at our disposal, the only way in which we can use it is by increasing either the capacity or the voltage, or both. Now when, as on page 332, we substitute for our closed oscillatory circuit the open oscillatory circuit represented by the aerial of Figs. 1 and 5, we meet with the difficulty that unless we make this aerial very unwieldy and costly we can only give it a very small capacity; so that in order to store up in it the power that we require, our only resource is to charge that capacity up to a very high voltage. That means that the air-gap must be so long that it will only break down at a very high voltage; so that to use much power we must have a very long spark-gap between aerial and earth. Although as we have said that the air, when a spark is passing, becomes momentarily a conductor, yet like all conductors it has a certain resistance, and, as a matter of fact, this resistance is a good deal higher than that of the rest of the circuit; moreover, this resistance increases with the length of the gap. But we have seen on p. 262 that in an oscillatory circuit the introduction of resistance is a bad thing, causing a waste of energy, and a rapid dying-away of the oscillations; so that the introduction of a spark-gap between aerial and earth cannot be considered a good thing unless the gap be very small. Thus if, in order to utilise the power we require, we have to make this spark-gap of a considerable length, then the arrangement becomes much less efficient. This is not the only argument against the use of "plain aerial" with long spark-gaps; the mere fact that we have to charge our aerial to a very high potential is in itself bad, for at a certain voltage the wires begin to "brush" and discharge their electricity to the surrounding air, causing a considerable loss of energy; further, the difficulty of maintaining a sufficiently good insulation of the aerial to withstand such a high voltage becomes very serious in wet weather.

It is clear, therefore, that with a given aerial we cannot successfully increase the power we can put into it beyond a certain limit if we adhere to the "plain aerial" or "direct excitation" method.

35. **Indirect Excitation of the Aerial.**—Returning to the other kind of oscillatory circuit, the "closed" circuit, shown in Fig. 9, p. 336, we see that we can increase its capacity far more easily than we can increase the capacity of the aerial, so it is easy to make such a circuit capable of utilising a large amount of energy without using a long spark-gap. It is true that the size of this capacity is limited by the length of the wave we wish to send out, for, as we

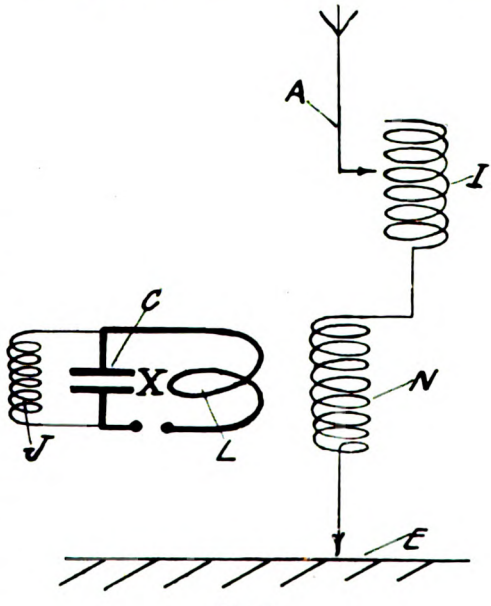

Fig. 1.

know, the wave-length depends on the product of the capacity and inductance, and however short we may make the leads from the condenser to the spark-gap, we cannot reduce their inductance below a certain amount. But this inductance can naturally be made far smaller than the inductance of the long aerial-wires, and therefore the capacity of the closed circuit can be made many times larger than that of the aerial, and the circuit will still give the same wave-length as the aerial. Such a closed circuit—as we saw on p. 263—is, however, not a good "radiator"; that is to say, it does not readily send out waves into the

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æther, and is therefore not a good substitute for the open circuit provided by the aerial, which is an excellent radiator. If, however, we combine the good energy-storing property of the closed circuit with the good energy-radiating property of the aerial, we shall satisfy all requirements.

This is the plan on which is based the "coupled-circuit" transmitter now in general use, a diagram of which is shown in Fig. 1.

The closed oscillatory circuit, X, is set oscillating by charging up the condenser, C, until a voltage is reached at which the spark-gap breaks down. The oscillating currents thus set up pass to and fro round the circuit, which includes, besides the usual leads from the condenser to the spark-gap, a coil, L, consisting of one or more turns of

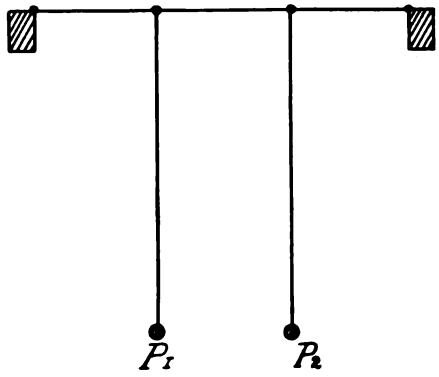

Fig. 2.

wire. This coil is so placed with respect to another coil, N (usually of six or more turns), that the two coils exercise magnetic induction (see p. 111) on each other. One end of this second coil is connected through a variable inductance, I, to the aerial, A, and the other end to earth, E. The oscillating currents flowing through L create, through the mutual inductance of the two coils, oscillating currents in the aerial, thus setting the latter oscillating. If, however, the values of capacity and inductance of the aerial circuit are arranged so that the aerial has a frequency different to that of the closed circuit, the aerial will try to oscillate at its own frequency in opposition to the oscillations put into it by the closed circuit, with the result that one set of oscillations will interfere with the other, and very little energy will be transferred from the closed to the open circuit. Under these conditions the two circuits are said to be **"out of tune,"** and we may take it that the first oscillation in the closed circuit induces a wave in the aerial coil; this wave travels up the aerial, reaches the free, insulated end, turns back and tries to return to earth; but on its way there it meets another wave coming up the aerial, induced by the second oscillation in the closed circuit which is not "keeping time" properly with the aerial, and these two waves partly destroy one another.

But if the aerial circuit is so arranged as to have the same frequency as the closed circuit, the first wave, instead of meeting a contrary wave, will travel down to earth unhindered, and as it swings back again it will find the second wave, induced from the closed circuit, ready to join it in its progress up the aerial and down again to earth; and this will go on, one wave adding on to the others already in the aerial, until the condenser, C, is discharged; that is to say, until the energy originally stored up in the closed oscillating circuit is transferred to the aerial. Under these conditions the two circuits are said to be **"in tune."**

36. A simple experiment can be made with pendulums, which illustrates this point.

A piece of string is stretched between two fixed points, Fig. 2, and two pendulums, P_1 and P_2, are hung from it a short distance apart. Now if these pendulums have the same time of swing, and therefore the same frequency, they may be said to be **in tune,** and it will be found that if P_1 (which may be taken to represent the closed oscillatory circuit) be started swinging, it will, owing to its being coupled to P_2 by the string A, gradually start a similar swing in P_2.

The swing in P_2 will get greater and greater until the energy that was originally put into P_1 is transferred to P_2, and P_1 will have come to rest.

If, however, P_2 be made shorter or longer than P_1, so as to have a different frequency, the two pendulums may be said to be **out of tune,** and it will be found that, although a certain amount of swing will be induced in P_2, the two pendulums will interfere with one another, and *both* will come to rest after erratically jerking about.

Clearly, therefore, it is most important that the two circuits shall be "tuned" to

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the same wave-length ; and, if this is done, the aerial is kept supplied by the closed oscillatory circuit with energy to radiate.

Since the capacity of the condenser, C, is many times that of the aerial, it can be made to store a large amount of energy even though the voltage is kept comparatively small ; so that instead of having a long spark-gap introducing a good deal of wasteful resistance in the aerial circuit, we can have quite a short one, with a small resistance, in the closed circuit, and none at all in the aerial circuit.

This closed circuit is spoken of as the **"primary" circuit;** the two coils, L and N, form together an **"oscillation transformer"** or **"jigger,"** the coil L being the **"jigger primary,"** and the coil N the **"jigger secondary."** The variable inductance, I, which is, of course, used to alter the wave-length of the aerial circuit so as to agree with that of the primary, is called the **"aerial-tuning inductance."**

In order to be able to adjust the primary circuit to the exact wave-length required, some part of its inductance is generally made variable. Sometimes this is done by making the coil of several turns, one, two, or more of which may be included in the circuit for tuning purposes.

37. **The Auto-Jigger.** — In the above method of indirect excitation we had two entirely separate circuits, the primary circuit and the aerial circuit, connected by *no conductor*, but only by the mutual induction of jigger-primary and jigger-secondary ; and we saw that, provided each of these two circuits was tuned to the same wave-length, the arrangement offered us an excellent combination—a good storer of energy combined with a good radiator of energy.

There is another form of indirect excitation, using what is called an auto-jigger, which at one time was fairly extensively used, and is still popular among amateurs owing to its simplicity.

In this auto-jigger arrangement we still have the two circuits—the primary circuit with its condenser and jigger-primary, and the aerial circuit with its aerial, its tuning inductance, its jigger-secondary and its earth, and these must be tuned to the same wave-length just as in the case of the ordinary jigger (though this fact is often neglected by amateurs) ; but in the case of the auto-jigger the primary circuit is in actual metallic connection with the aerial circuit ; in fact, the jigger-primary is formed of a certain number of turns of the jigger-secondary itself.

Thus in Fig. 4, which illustrates the auto-jigger, the aerial circuit consists of the aerial, A, the aerial tuning inductance, B, the jigger-secondary, CD, and the earth connection, E ; while the primary circuit consists of the condenser, F, the spark-gap, G, and the jigger-primary, D, which is merely a certain number of turns of the jigger-secondary, CD.

With such an arrangement we have the same advantage as with the ordinary jigger—namely, a good storer of energy (the

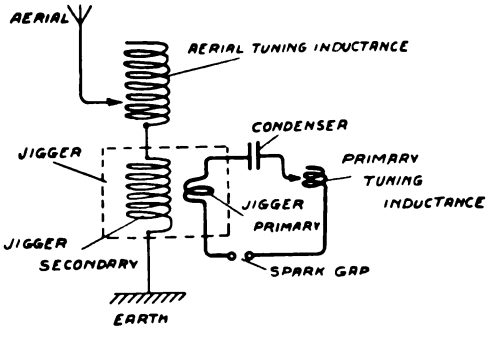

Fig. 3.

closed oscillatory circuit containing the large condenser, F) transferring its energy, through the action of the coil, D, to the good radiator (the open oscillatory circuit, ABCDE).

The auto-jigger, however, has certain disadvantages, which we shall see presently.

38. **Reaction of Secondary on Primary.**— The behaviour of a coupled--circuit transmitter, whether an ordinary jigger or an auto-jigger, is less simple than would appear at first sight.

It might seem natural to suppose that since the primary circuit has the same wave-length as the secondary or aerial circuit, it would simply transfer its energy (put into it by the induction-coil) to the aerial in the form of oscillations of the same frequency ; and that the aerial would radiate out this energy in the form of æther waves of the length corresponding to that frequency.

But we must remember that just as the

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currents flowing to and fro in the jigger-primary induce currents in the otherwise passive secondary, so do the currents (thus made to flow in the secondary) act on the primary and induce currents in it; so that when the primary circuit has given up its energy to the secondary, the latter starts giving back some of its energy to the primary, which returns it to the secondary, and so on. This goes on till so much energy has been removed from the circuits—by losses in resistance and by radiation from the aerial—that the current in the primary has no longer power to cross the spark-gap, when the process stops until it is started again by the induction coil charging up the condenser once more.

39. This will be more easily understood by referring again to the pendulum experiment described in par. 36 (p. 397). In this paragraph we only followed the action of the

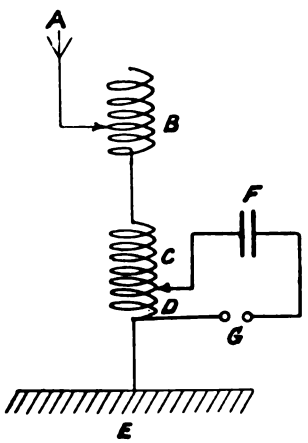

Fig. 4.

pendulums up to the moment when the driving pendulum, P, had transferred its energy to P_2, but, if we watch their action still further, we see that P_2 now becomes the driving pendulum, and its energy will gradually be transferred back to P_1, and this transfer of energy goes on backwards and forwards until so much energy has been lost in friction in the air and string that both pendulums come to rest.

Now this rather complicated give-and-take process has a peculiar effect on the wave set up in the aerial.

The result of coupling a closed oscillatory circuit to an open oscillatory circuit, each of which is tuned to the same wave length, is the production of two wave lengths, one longer and the other shorter than the wave length to which both circuits have been tuned. These two wave lengths are known as the **Resultant Wave Lengths.**

40. It is not an easy subject to understand, but it is a very important one, and our readers are recommended to take pains to understand it.

Resultant Wave Lengths of Coupled Circuits.—The jigger-primary has a certain amount of inductance (which has already been defined) due entirely to itself—its number of turns, its diameter, the spacing of its turns, etc.; this is called the **self-inductance of the primary.**

Similarly the jigger-secondary has a certain self-inductance, due to its number of turns, diameter, spacing of turns.

But besides these two self-inductances, which would remain unaltered if the primary were taken to the Equator, and the secondary kept at home, there is a third inductance which affects both primary and secondary, and which is due to the proximity of the one coil to the other. This is called the **mutual inductance;** thus the primary has, in addition to its self-inductance, the mutual inductance due to the effect of the secondary, and the secondary has, in addition to its self-inductance, the mutual inductance due to the presence of the primary. This mutual inductance depends on the position of the primary with regard to the secondary, on their distance apart, and on the number of turns acting on each other.

The mutual inductance of two such coils, though it is an abstract kind of thing which cannot be seen, is nevertheless a definite quantity, and is very important, as it is through the agency of the mutual inductance that the primary circuit is able to transfer its energy to the aerial circuit.

41. Let us suppose for the sake of simplicity that the self-inductance of the primary circuit is equal to that of the secondary circuit; we know that the wave-lengths of the two circuits are the same, but as a rule the inductance of the primary is much less than that of the secondary, so as to enable the primary condenser to be of much larger capacity than that of the aerial; there is no reason, however, why we should

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not for the sake of argument make the two capacities equal, and therefore the two inductances also equal. Let each of these inductances be L, and let the mutual inductance between primary and secondary be M.

Now the give-and-take process which we described above has this result: it makes the mutual inductance M *add* itself to the self-inductance L at one moment, and then, a fraction of a second later, it makes M *subtract* itself from L. The result is that at the first moment each circuit behaves as if its total inductance were L+M, and at the next moment as if it were L−M. But these moments are so close together—separated only by such an infinitely small fraction of a second—that what happens is that the circuits appear to possess these two values of inductance *at the same time;* so that they behave as if, instead of each having an inductance, L, they each had two different inductances, L+M and L−M.

But if a circuit has two inductances and one fixed capacity, it is clear that it will give two wave-lengths; and, as a matter of fact, the result of the give-and-take action between primary and secondary is that the aerial sends out two waves, one longer and one shorter than the wave to which both the primary and aerial circuits were tuned.

It is clear that the production of these two waves is governed by the size of M compared with L; if we make M very small compared with L by increasing the distance between the primary and secondary of the jigger, L+M will only be very slightly larger than L−M, so that the two waves will be so nearly equal as to be indistinguishable.

So if we move the jigger-primary farther and farther away from the jigger-secondary, we can reduce M and make the two waves approach nearer and nearer to one another, till finally they merge into one wave length which will be of the same value as that of the circuits taken by themselves.

We assumed, for the sake of simplicity, at the beginning of paragraph 41, that the inductance of the primary was equal to that of the secondary. If, as is usual, these inductances are different, the same thing holds good, except that the simple formula of L+M and L−M becomes somewhat more complicated and elaborate.

AMATEUR NOTES.

A MEETING of the Liverpool and District Amateur Wireless Association was held recently, when it was announced that Professor E. W. Marchant, D.Sc., and Mr. L. S. Cohen, had consented to act as vice-presidents. The subject of "extreme" protection against lightning risks was again referred to, when it was suggested that a double pole two-way switch could be used for the purpose of earthing both aerial and also metal guy ropes, if thought necessary. On Saturday afternoon, August 9th, the Association paid a visit to the Formby Power Station of the Lancashire and Yorkshire Railway.

* * *

A meeting of the Birmingham Wireless Association was held recently at the club room. The chair was occupied by Mr. P. S. Beaufort, and a paper was read by the vice-president, Mr. W. F. B. Bartram, on "Atmospherics and Interferences in Radio-telegraphy." The paper was devoted chiefly to commercial stations. Mr. Bartram gave the connections of and described the Marconi multiple tuner. From this subject he went on to that of lightning, and some extremely interesting facts were forthcoming. A warning was given to all those who are in the habit of earthing their aerial to gas-brackets, and is one which cannot be too strongly emphasised. This was followed by a short and interesting description of one of the members' transmitting apparatus. This station is the work of Mr. H. Littley, and is situated in West Bromwich. The aerial is supported in three places by steel towers 78 ft., 65 ft., and doubling back underneath to 45 ft. It is composed of 26 wires 95 ft. long, making a total, with leads-in, of 2,700 ft. The aerial is in two parts, and can be used separately or together. The town supply of 230 volts D.C. is used, being generated into 110 volts A.C.; a 6 in. coil, with spark-gap of zinc electrodes ½ in. in diameter. The wave-length is about 300 metres, and Mr. Littley has been heard in London. Mr. Littley has promised another and fuller description of his station at a future meeting. The secretary is very anxious that those members—a great number—who have not yet filled in the particulars of their stations on the forms provided should do so at once.

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Our Bookshelf

"WIRELESS TELEGRAPHY," by Professor C. L. Fortescue. (Camb. Univ. Press. 1s.)

Professor Fortescue sets out to help the reader who, "possessing a general scientific knowledge, is anxious to know something, not only of the accomplishments of wireless, but also of the means by which they are obtained." This he accomplishes admirably in a little book of some 140 pages, every one of which is eminently readable and instructive. The first four chapters, explaining the electrical phenomena which are involved in the processes of wireless, should—with the help of their mechanical analogies—give the reader a sound and clear basis on which to erect the facts which may be accumulated from the later chapters; and without such a basis—which we have found to be none too common—the amateur's notions on the subject of wireless are inclined to develop into a confused mass of uncorrelated facts which impede rather than assist progress.

The later chapters, which include references to the various "systems," are written from a thoroughly unprejudiced standpoint and, on the whole, give a very fair representation of the state of affairs at the present day. We think, however, that Professor Fortescue is inclined to optimism when he speaks of the continuous wave processes; he does not mention, for instance, the serious difficulty which is presented by the tendency of continuous-wave generators (such as the high-frequency alternator) to vary the length of the wave emitted, and thus to vitiate all their advantages of sharp tuning; and he pays particular attention to the assertion that a much smaller aerial can be employed with continuous waves than with non-continuous waves. This is certainly a point which remains to be proved by practical experience; and when we read of the "antenna of enormous spread" used at the Goldschmidt station at Slough, and see the great tower which it has been thought necessary to erect at the Goldschmidt Hanover station, we cannot feel that the assertion is sufficiently well founded to deserve an unquestioned place in Professor Fortescue's book.

We also notice that on p. 64 the waves sent out by the Poulsen generator are described as "absolutely undamped," and productive of the "maximum of selectivity." That we are not inclined to agree with this statement can be seen by reference to the article on the Poulsen System which appeared in the July number of THE WIRELESS WORLD.

Professor Fortescue distinctly over-estimates the power which it is proposed to use at the great stations of the "Imperial Scheme," when he states (on p. 114) that in a three-way station, when transmission is taking place simultaneously in all three directions, three sets, each of 2,500 horse-power, will be in use at the same time, thus making a total of 7,500 horse-power. He has evidently misread the draft specification, which shows that the "total power" at certain of these stations will be 2,500 horse-power. We like Professor Fortescue's irony on the subject of the wireless telephone, which will be appreciated by readers of popular journals. After describing some of the successful results in telephony, he goes on: "Latterly it appears that rather less interest has been taken in the problem; at any rate, fewer 'Inventors of the Wireless Telephone' have appeared."

No reader of THE WIRELESS WORLD should fail to get this excellent little book.

* * *

We have just received the illustrated report of the International Congress of Practical Telegraphy, which was held in Turin in 1911. This Congress, it will be remembered, was arranged to celebrate the jubilee of the formation of modern Italy. This official report of the events which took place is worthy of the occasion which it commemorates. It is handsomely produced, is full of most interesting matter, and is beautifully illustrated; more especially are we struck with the excellence of the designs which ornament its pages. It is also interesting to note that the work of Mr. Marconi receives due acknowledgment, and, further, that a Marconi wireless station has been used in the decorative scheme for one of the clever certificates presented with the prize by the Minister of Posts and Telegraphs for a national competition in telegraphic efficiency.

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HINTS FOR AMATEURS

Some Experiments with Aerials for "Receiving"

By W. HARRIS SHADDICK

WIRELESS experimenters are constantly erecting quite efficient aerials, yet, much to their disappointment, they frequently "receive" nothing. Shall we take an example? An intelligent enthusiast recently fitted up his aerial according to up-to-date principles. This aerial was some 200 feet long, and over 50 feet from the ground. The situation was quite suitable, and the "earth" was excellent. He had spent freely on his instruments, and had in this case obtained proper workmanship for his money.

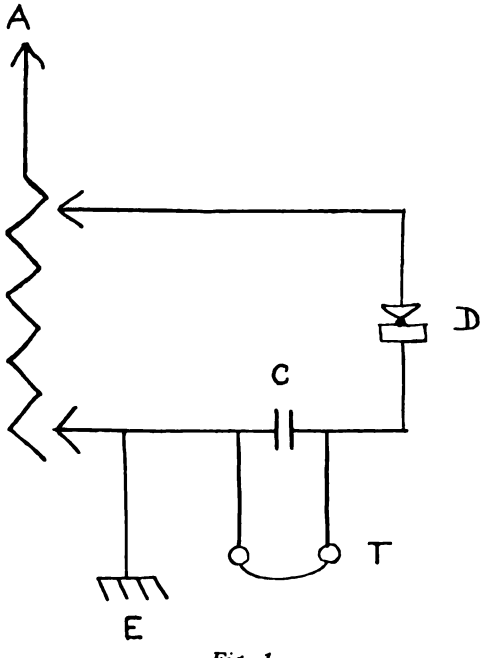

Fig. 1.

His inductance was 10 inches long and 6 inches in diameter, wired with No. 20 enamelled copper wire.

The telephones were of the correct high-resistance type.

As to the detector, its efficiency was equal to its attractive appearance.

Remembering all, there should be nothing wrong. But weeks went by, and our wireless man received no message. He *was* disappointed.

Presently he began to reason and then to make inquiry, with the very common result that he was told to blame his aerial.

The advice was wrong. The trouble was minute, and it was not in the "heavens."

This man is typical of numerous experimenters.

Recently I carried out a number of experiments in the hope of demonstrating that aerials of very imperfect construction and of short length can really yield excellent "receiving" results. These experiments will further prove the futility of casting the common blame upon the said aerials. All these trials have been undertaken round about and in the house. There has purposely been no special endeavour to fit up the perfect antenna. Rather, insulation has been mainly neglected, and the erection has generally taken minutes instead of hours and days. And what has been the invariable sequence of these operations? The answer is: one readily gets from these impromptu aerials all, or nearly all, the average wireless man desires.

So the following experiments will first show that the non-receipt of signals does not necessarily depend upon the antenna. Secondly, the inquiries will prove the utility of these particular aerials in confined places such as oftentimes belong to Boy Scouts. They will also indicate very clearly that for receiving messages by wireless a big outdoor aerial is not an absolute necessity.

I will begin with the instruments used in these experiments.

First, a word about the inductance. This I made for special and outdoor work. It consists of a little less than 1 lb. of enamelled copper wire, No. 24 gauge, wound on a cardboard cylinder 11 inches long and 4½ inches wide. The wiring was bared for about ½-inch in two places for brass ball-sliding contacts.

As to the detector. This was quite a home-made affair, bringing very simply a zincite point on to a morsel of copper

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pyrites. The telephones were double and of 4,000 ohms together. I used as an extra aid a condenser consisting of 18 pieces of tinfoil, each 3 inches by 1 inch, alternating with paraffin paper. This was used for "shunting" the telephones, and was placed between the detector and the "earth."

For aerial I bought two separate ½-lb. reels of gauge 19 bare copper wire to be used in parallel, two light wooden rods some 3 feet long to act as "spreaders," and two porcelain reel insulators.

Fig. 2 shows the complete apparatus.

A few words about the situation of the house. It faces nearly east and west. The front is a part of the Epping Forest, free of

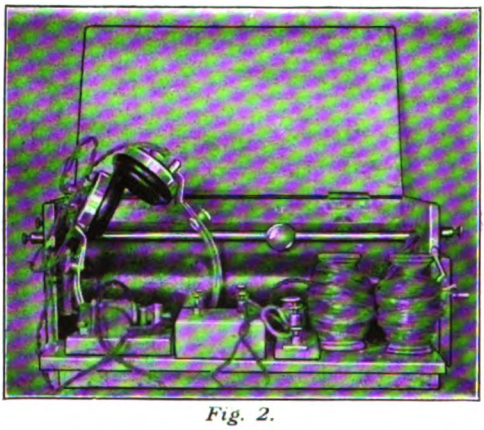

Fig. 2.

trees, but for two 50 feet poplars abutting on to my residence.

The back of the house is roughly enclosed by buildings on three sides, but it is saved by its garden, which is 80 feet long and 60 feet wide. This garden has its share of trees of different kinds, varying from two poplars nearly 50 feet high down to others 20 feet in height.

From a wireless point of view the situation is not ideal. My "earths" were at the front and the back, two separate ones. At the front I buried 4 feet deep 1s. worth of galvanised iron wire netting; at the back, at the same depth, a tangle of waste wire representing not more than a 20 feet length.

Now for the experiments:

EXPERIMENT 1.

Laboratory Aerial.

My laboratory is a room situated at the back of the house, and is 24 feet long. It is comfortably filled with all the usual chemical and electrical apparatus. The aerial was suspended 3 feet from the ceiling, its mean height being 18 feet from the ground level.

The total length of the wiring from the extreme ends of the room was 24 feet plus 6 feet to the instruments upon a table.

The insulation was very simple, consisting only of two small reel insulators, one for each end of the aerial at the extremities of the laboratory. These insulators were merely strung upon two French nails driven into the walls.

Result.—The practice signals from certain London schools, together with those from a well-known suburban experimenter, were very readable. Norddeich lacked volume, and was just audible. Paris time and weather reports came in on the loud side.

Considering the amount of inductance necessarily used, and the meagreness of the aerial, the results were really excellent.

Norddeich was certainly disappointing. But I do not attach much importance to this item, for such is oftentimes the case on bigger aerials than this 30 feet one.

EXPERIMENT 2.

Roof Aerial.

In this experiment the commencement of the two wires was attached to the insulators strung on wooden posts driven into the ground. These posts were 10 feet in an oblique line from the laboratory window. The wires advisedly were just 6 inches from the ground. They were from this point drawn directly up to the roof and allowed to rest upon the tiles, passing over and touching the guttering. At this position they were separated by a "spreader," and dropped to the ground level at the front of the house. Holes were drilled in the window frame, allowing the ends of the wiring to pass directly to the instruments in the dining room.

Results.—With upwards of 70 feet of aerial thus improvised Paris signals were fairly loud—Cleethorpes was more than readable. Some 300 to 600 metre wavelength signals were excellent.

I was able to test this aerial during rain—as might be expected, the results were impoverished, but by no means to the extent of destroying them. "Earth" sounds were too apparent for comfort. But, taking things all round, the signals

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were good, and approximately about three-quarters as loud as those received over my big and well-constructed aerial.

EXPERIMENT 3.

Portable Garden Aerial.

For the purpose of this trial a table was placed at the laboratory window. Upon this table was stood the inductance, to which one end of the aerial was suitably attached. From here the wiring was continued to the bottom of the garden.

No attention whatever was paid to the trees and shrubbery *en route*. In fact, two trees at the opposite sides of the garden were utilised for securing the ends of the two wires.

Here are the dimensions of this portable aerial :

	Feet.
Length from laboratory window to bottom of garden ...	80
Wires spaced at bottom of garden	50
Average spacing of wires ...	40
Average height above ground	12

Results.—Cleethorpes was clear, and easy to read. Certain distant stations, French and German, were very busy during this experiment. The " calls " were really excellent. This aerial was, for some reason, better suited for its work than my principal one, much higher, and properly insulated. The reason may be apparent, but I will not discuss it here—suffice it to say I was highly pleased with the results of this trial, especially as all correct insulation was barred.

EXPERIMENT 4.

Loft Aerial.

The two reels of wire were unwound in my loft in opposite directions, commencing at the door. They were separately placed on the beams, and their ends drawn through the ceiling to the inductance in my laboratory below. In this way each reel furnished some 30 feet of wire, which represents the length of this aerial. The wires at their utmost divergence were separated by some 25 feet. There was no insulation beyond what the woodwork furnished.

Results.—The usual stations were also very busy during this experiment. " Paris news " in the neighbourhood of 9 p.m. was somewhat inferior to what is furnished over my principal aerial. But there was no mistake about the clearness of the signals given. Cleethorpes was more than passable, for the notes so often blurred were in this case distinct and clear.

Foreign stations were also in evidence, together with certain ubiquitous amateurs, so much noted in these parts for their never-dying " V's." I found there was a distinct advantage gained by lengthening the " lead." This is quite reasonable. With proper precautions and facilities to extend the wires one could almost be tempted to speak glowingly of loft aerials. It is no small thing to remember that the aerial is here hidden from sight.

EXPERIMENT 5.

Dining Room and Hall Aerial.

The aerial for this trial was just 26 feet long, and was suspended from insulators similarly to the laboratory aerial. Its height was 8 feet from the floor, being about 3 feet below the ceiling of the dining room and hall.

Results.—Paris messages were just readable. Two 300 metre wireless signals came through loudly. But, on the whole, this experiment did not furnish data nearly so good as was the case one floor above.

Summary of Results.—These five experiments do not represent the whole of those undertaken. They are offered as a fair sample only.

The principal thought driven home is, that the experimenter must not be so ready to blame the aerial. In nearly every case the failure to " receive " should be looked for elsewhere. Upon this point one could write a great deal as a result of several years' experimenting.

A second lesson may be learnt.

There is really no necessity to go to the great expense and trouble oftentimes borne so patiently and perseveringly by our wireless friends. They must really learn that these electro-magnetic waves, representing messages from the wide world o'er, attach themselves in unlooked-for places.

I will grant that generally a moderately high aerial will be more satisfactory than a low one. Certainly, also, a fairly long aerial is to be preferred to a short one.

But if a high and long antenna is not available, then one on the lines described will furnish both pleasure and profit.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

W. P. (Lanark) shows from his question that he had better study the instructional articles now appearing in THE WIRELESS WORLD before attempting experimental wireless.

L. P.—For answer to your question, "How do you set about getting the consent of the Postmaster-General?" write to "The Secretary, General Post Office, London," who will send you an application form.

L. F. wants to know how to rig up a small wireless station. An old motor-cycle ignition coil will do for the transmitter, and a simple crystal receiver for the receiver. An aerial-wire (vertical) about 20 feet high is needed at each end.

J. F. W.—Size of helix, etc., has little to do with distance of transmission; height of aerial (which you do not even mention) has a great deal. Evidently you need to read the series of instructional articles very carefully before commencing work.

W. H.—Read our instructional articles and the answers to other people's queries. Apparatus by which you would be able to pick up messages from big stations, and so practise "receiving," would not be very complicated or costly, but you would have to spend a guinea on the licence.

D. C.—Read our instructional articles, answers to queries and amateur contributions. Your aerial is too low to be of any use for distance-working. You must raise the lower end so as to give it a better average height; this should be 40 feet or so. Use a tree or a chimney if you cannot have a mast.

D. N.—The low resistance of your telephone is quite enough to explain your not getting any results from distant stations. Also do not forget that your aerial-inductance-earth circuit and your condenser-inductance circuit must both be tuned to the wave you are receiving. To do this really requires a wavemeter.

J. H. H.—Connections not good. See other replies to queries. Your "load-coil" sounds as if it were wound in several layers; if so, this is fatal. Use thinner wire—say, No. 30—in a single layer. Read our instructional articles. What crystals are you using? Are you sure they do not require a battery and potentiometer?

G. CONTI.—We think the amended sketch you send us should be satisfactory. The variable condenser across the jigger-secondary must, of course, be very small. You may find tuning-up rather difficult; we shall be glad to hear how you get on. It would be interesting to hear how this compares for selectivity with the ordinary circuits.

S. S.—Is it possible to use a Morse inker for recording messages from Eiffel Tower?

Answer.—Certainly. The coherer and relay would be the simplest method, but a relay can be made which would work off a crystal or a Fleming valve and operate a Morse inker, especially with such strong signals as those you mention, received on a good aerial.

F. L. S.—I am making a rotary condenser, and find that the plates touch, although the distance between the moving and the fixed vanes is over one-sixteenth of an inch. What is the cheapest remedy? Must paper-ebonite be used, or will shellaced paper do?

Answer.—Dip your vanes in shellac varnish, allow them to dry, dip again, and so on, till a thick coating is obtained.

Q. O. X.—It is certainly possible to make a bell ring over the distance mentioned by you, but not, we fear, with the relay you have. The ordinary bell coils do not make a nearly sensitive enough relay for wireless at any distance. As for setting the bell so as to be rung by a particular station, this also can be done, but not with simple apparatus; for such would be liable to be set going by any stray atmospheric.

C. R.—We cannot reply to questions like your first and second. It is contrary to etiquette. No station has such flat tuning as to be receivable "anywhere between 600 and 3,000 metres." Loosen your coupling or lower your aerial, and tune properly; the station is so near that it is forcing its wave on your receiver. Take care that all your receiving circuit leads are as far as possible from, and at right angles to, your lighting leads.

R. R. H.—Using such thick wire, probably you have not nearly enough inductance to tune your aerial to the long waves you are looking for. Since you have no condenser, and therefore only one oscillating circuit, the tuning coil with tappings is entirely wasted in the position you give it. Put this one in series with the aerial in addition to the other. Even so, you will probably need more inductance. And you must certainly insulate your aerial at both ends.

J. B. W.—In the case of a flat spiral, *i.e.*, only of one wire thickness, the formula holds. Probably in an induction-coil secondary section the error will not be great. But there is the danger of the capacity-effect from turn to turn. No. 32 wire would not cause serious loss through its resistance. But the use of such coils is entirely experimental—they are not as efficient as the ordinary single-layer coils, where the proportion of the number of turns in primary and secondary can be arranged to best advantage.

J. W. T.—(1) Your diagram, though neat enough, is the most mysterious of all those we have received. No indication is given as to where the three terminals shown are connected with the tuning inductance or its sliders; no parts of the apparatus are labelled, and some of it is quite beyond our powers of guessing. Study the diagrams appearing in many places in THE WIRELESS WORLD, and learn how to represent what you want to represent. (2) Yes. (3) *a*, by a Wheatstone bridge; *b* and *c*, best for you to test these on actual received signals; *d*, test for short-circuit, and if possible insulation-resistance and capacity.

X. T.—*Answer.*—(1) Two chokes are necessary, one in each lead from transformer. Wire enamelled will do. About 200 feet each coil. (2) Losses in the loops are negligible probably less than those which might be introduced by extra joints. (3) Immaterial for ordinary reception, provided resistance of whole circuit is not too

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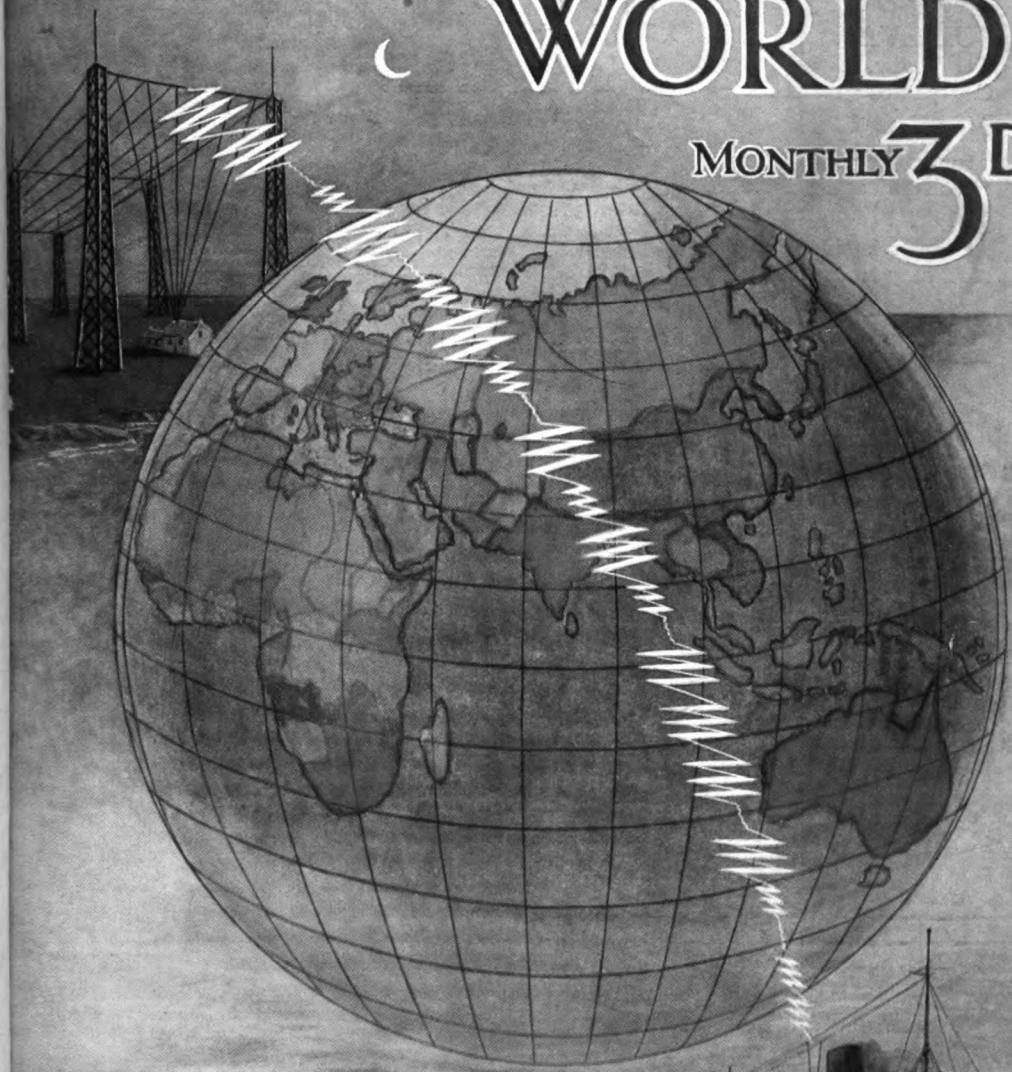

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The Editor will be pleased to receive contributions; and illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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Safety on Railways

REMEMBERING what wireless telegraphy has already done in saving life and ships at sea, it is not unnaturally asked whether this remarkable invention cannot be employed in connection with our railways, and thus minimise the danger of accidents, of which the Aisgill disaster last month is a terrible example.

The advance which wireless telegraphy has made within a comparatively short period discourages any attempt to fix limits to its application. It has become a vital aid to the safety of shipping and an instrument of ever-increasing value to social and commercial life. Will equal success attend the efforts which are now being made to introduce it on railways? The matter is still in a more or less experimental stage, and it is impossible therefore to answer the question with absolute confidence.

Some guidance should be furnished by the trials which are now in progress on the Lackawanna Railroad, in America, and of which we give a few particulars on another page. The problem there is being approached in a scientific manner, and from the advanced state of the art it is fair to presume that the element of chance in the attainment of results will be largely reduced if not entirely eliminated. The distance to be covered by the wireless in this instance is comparatively short, and if the system proves to be as successful as it is hoped it will be, it will mean a great deal to the railway services. The section of the road to be equipped is one which is frequently visited by storms, and wire communication suffers more or less in consequence. In order to be independent of such conditions, the railway officials find hope for relief in the wireless, and if they succeed in accomplishing what they have undertaken a great stride will have been made in the development of the science of railway-train movement.

The far-reaching effect of this undertaking is at once apparent, for comfort, convenience and increased safety must follow from the successful operation of this remarkable innovation. For instance, in approaching a station, a conductor of a train will be able to notify the agent there that he is in need of an extra car, and transmit similar information which will enable the station authorities to be ready to make the necessary changes or repairs immediately upon the train's arrival. It would be possible also to transmit news and other items of interest to a train while in motion. Whilst these advantages will be especially appreciated in North America, where railway journeys are often of several days' duration, travellers in this country, and on the long-distance railways of Europe, will not fail to note what remarkable possibilities are likely to be opened out by the successful accomplishment of the new application of wireless telegraphy. As a means of safety, the wireless service should prove of inestimable advantage, and in combination with other precautionary measures should still further diminish the danger of modern travel.

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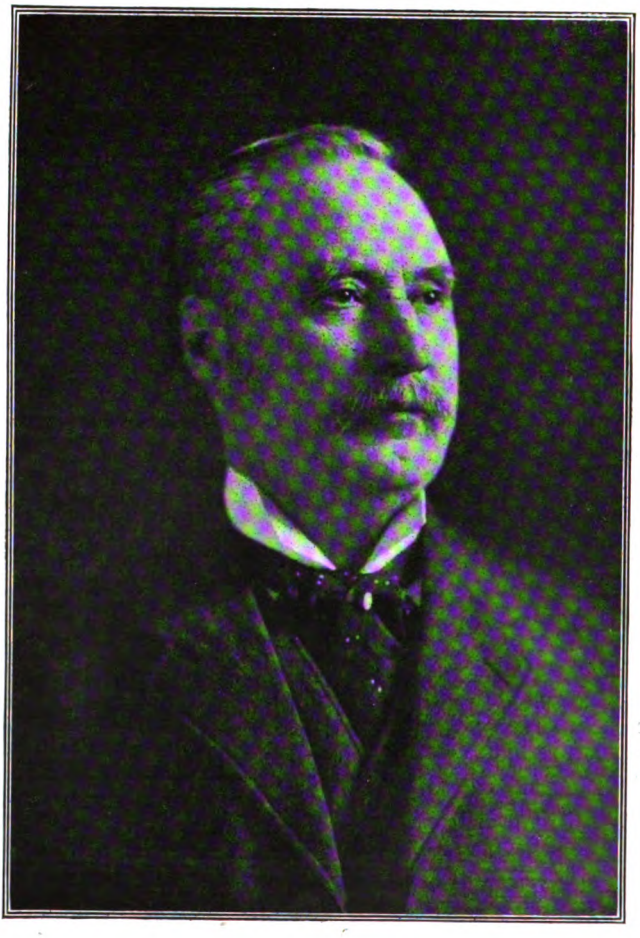

MR. R. BICKERDIKE, M.P.

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Personalities in the Wireless World

ROBERT BICKERDIKE, ESQ., M.P.

(Director of The Marconi Wireless Telegraph Company of Canada, Limited.)

THERE is always a certain class of unsuccessful man who is ready to disparage the abilities of his more fortunate *confrère*. "Money," he says, "is not necessarily apportioned to the most deserving. The game of Life's chances is played with loaded dice, and success falls to the man who has influence at his back. Further, this influence is obtained, not so much by personal qualities, as by force of circumstances." He forgets that though influence may gain a man his position, it cannot make him keep it, and furthermore, that it is a man's own personality which gains him the influence, for friendship, be it either commercial or private, depends on a number of good qualities, and cannot be bought at a price.

An instance of such a man is Mr. Robert Bickerdike, the director of several of Canada's most important industrial and commercial enterprises. Mr. Bickerdike is the son of the late Thomas and Agnes Forster Cowan Bickerdike, and is by birth and ancestry an Englishman. He was born at Kingston, Ontario, on August 17th, 1843, and was educated in the schools of his native town. He started his business career in Montreal, Quebec, and after gaining a preliminary knowledge of affairs, took over a live-stock exporting business. This he built up so rapidly and successfully that he soon became the largest live-stock exporter in Canada. After a time, however, he retired from this industry and devoted himself to finance, underwriting, and insurance. It says volumes for his business capacity that he was equally successful in these new ventures. As years passed he became more and more drawn into the political arena, and these dual interests have kept him one of the busiest men in Canada.

In 1897 Mr. Bickerdike was elected to the Quebec Legislature, and later he became a member of the Canadian House of Commons, a position which he still occupies, and which he successfully contested in the elections of 1900, 1908, and 1911. His business interests cover a vast field. Besides being a director of the Marconi Wireless Telegraph Co., of Canada, Ltd., he is vice-president of the National Real Estate and Investment Co.; Ex-President of the Montreal Board of Trade, and Ex-Active Chairman of the Montreal Harbour Commissioners. He is a director of the Canada Life Assurance Co., the Western Assurance Co., the British America Insurance Co.; the Imperial Guarantee and Accident Insurance Co., and of the Mount Royal Investment Co. He is also president of the Canada Securities Corporation and other similar concerns. Formerly he was Vice-President of the Bank of Hochelaga.

But Mr. Bickerdike does not confine himself to business; he devotes some of his time to the welfare of his fellow citizens in Montreal, and is Life-Governor of the Montreal General Hospital, and Hon. President of the Montreal Western Hospital.

His social interests include membership of the Rideau Club of Ottawa, and the Canadian, Montreal, and Canada Clubs of Montreal.

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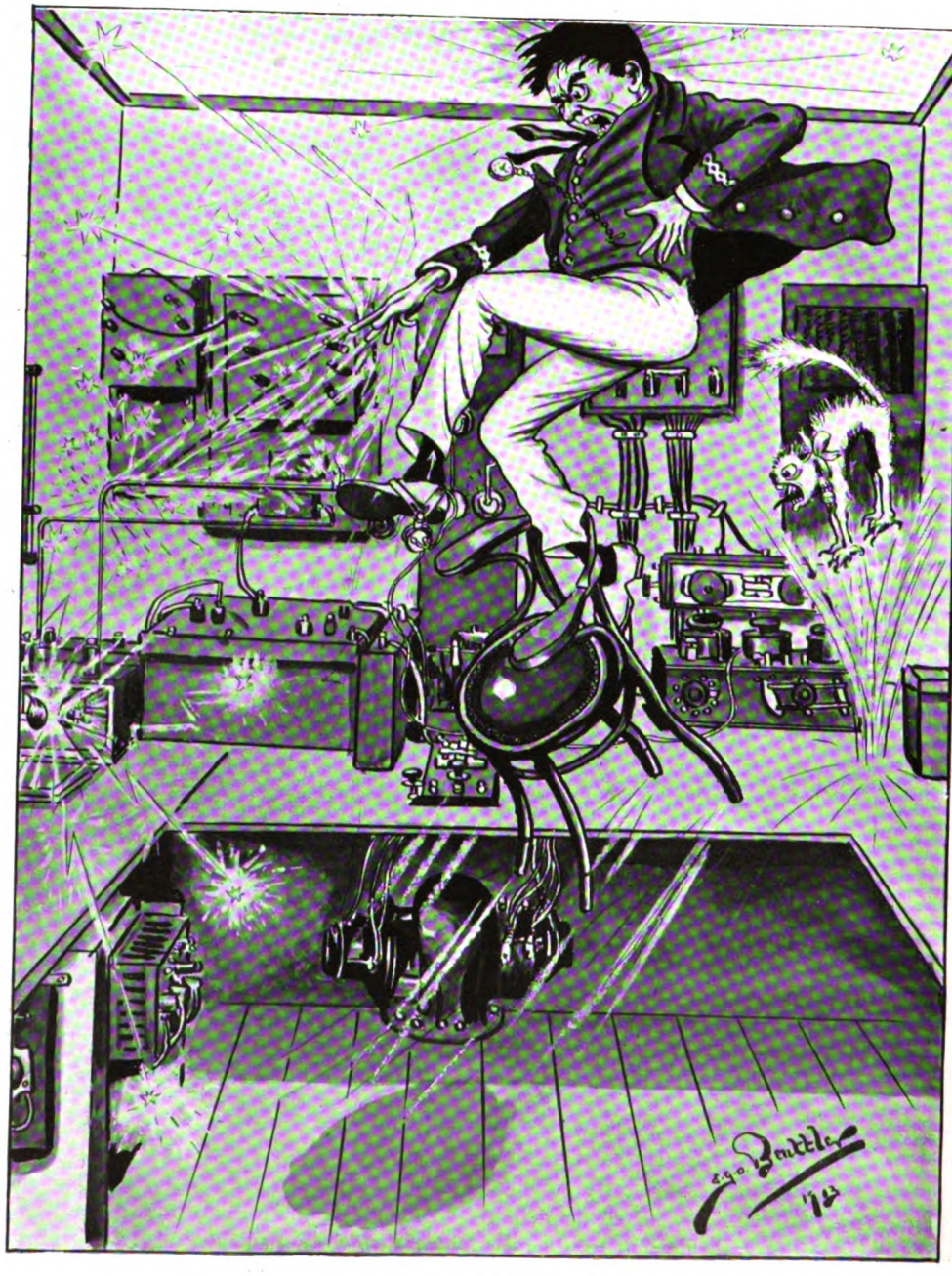
CARTOON OF THE MONTH

Wireless Terms Illustrated



VII.—The Booster

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Lightships

IMPRESSIONS OF A VOYAGE IN A RELIEF SHIP. LIFE AND WORK ON BOARD. "DROPPING THE SKIPPER." THE WIRELESS SERVICE

ONE-HALF of the world does not know how the other half lives. This saying is trite because it is so true, but its truth does not come home to one so forcibly as when visiting a lightship. Wireless, as most of our readers no doubt know, is installed on several lightships round the English coast, and it was with a view to obtaining some idea of its advantages and use that application was made to Trinity House for permission to board one of their vessels. The authorities not only were kind enough to grant this permission, but they arranged for a representative of this magazine to make a journey with their relief-ship, which carries provisions, coals, etc., to the stations once a month, so that he might visit several of their stations.

A start was made from Harwich at 6 o'clock on the Monday morning. The relief-ship was already laden with commodities, the hold was filled with a large and miscellaneous collection of goods, while on deck was stored a big consignment of coal, innumerable kegs of water, and a somewhat smaller supply of cans of oil.

By good fortune the weather conditions were perfect, there was not a cloud in the sky and the sea was only broken by summer ripples. We weighed anchor strictly to time and, carefully steering alongside the gunboat flotillas which were moored in the mouth of the harbour, made our way into the open sea. Never had life seemed so pleasant, with the freshness of the morning heightened by the saltness of the sea air and the early golden light making the old world town of Harwich, with its clustered gables, red-tiled roofs, white-washed walls and dark, half-ruined sheds, like some Turner landscape with its sober grandeur lit up here and there by patches of brilliant colour. Soon the harbour was left far behind us as we made our way past the Essex coast and Clacton, where the green fields and the low white cliffs showed up vividly against the margin of blue waters. Gradually, too, that disappeared and we were alone on the wide

The "Tongue" Lightship, which is fitted with Wireless Telegraphy.

sea making our way rapidly in a southerly direction to the "Gunfleet" lighthouse. This is quite a small station built on piles, and it looked very lonely situated so far out to sea, much lonelier indeed than the lightships, for they are bigger of bulk and look more capable of self help, though their greater security is probably more apparent than real. It was, of course, impossible for the relief-ship to come close to the iron girders which supported the short conical tower of the "Gunfleet," and so the consignment of goods was transferred to the ship's boats and thence hauled up to the storehouse of this human crow's-nest.

I was given a place with the coals in the jolly-boat, and after a somewhat dizzy ascent on narrow iron ladders found myself in the tower. The lower floor consists of three rooms, each the size of the proverbial pill box.

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Photo] [Lighthouse Mission, Belfast.
"Frying Pan" Shoals Light Vessel, off the coast of N. Carolina, U.S.A.

Lightship architecture must be an art of its own, whereof the chief requirement is to pack the greatest amount of convenience into the smallest possible space. For instance, the living-room in this establishment contained a stove, a sink, a pump, a dresser, a table, and a variety of cupboards, yet in shape it was an irregular triangle and there was scarcely a place where it was not possible by stretching out one's arms to touch the wall on either side. The sleeping apartment was even smaller, the bunks ranged one above the other with just room for lockers underneath; in the floor of this room was a small trapdoor which covered the fresh water tank. This tank was funnel-shaped so as to avoid any waste storage of this precious liquid. Precious indeed it is, for it adds much to the labour of provisioning these places. Thirty barrels per month was the amount allotted to the "Gunfleet," and although the crew worked with a will and a skill born of experience, it was some considerable time before the carriage and the emptying of the water kegs into the lighthouse tank was effected. In the meantime there were other provisions to be received and accounted for—the portions of rations allotted to each man sealed in little wooden kegs, the oil for the lantern (this is stored in great tanks that have a compartment all to themselves), then the coal, and last, but not least in the men's eyes, bundles of magazines and paper books, and, most precious of all, a little square box marked with the mark of Trinity House Library containing some twenty novels. This book-store, as may be imagined, does much to relieve the tedium of the lightship-man's secluded existence. Every month the relief-ship brings to the vessel it is relieving a similar square wooden box and takes away the former consignment.

While the lading and unlading was in progress I journeyed up another narrow staircase to see the lantern. Its mechanism was fluently and ably explained to me by the man in charge, who took, not unnaturally, a very great pride in his machine. It was one of the newest type and is fed by oil which by a new process is vaporised into gas, so that it can be used with an incandescent mantle. These mantles are of Brobdingnagian dimensions and give out a light of something like 80,000 candle-power, and should this not be sufficiently effective the bracket can be fitted with three mantles in order to give a more powerful beam. Everything, of course, was spotlessly clean and shining, not a fraction of dust or a spot of oil to be seen anywhere, nor was there

Photo] [Lighthouse Mission, Belfast.
"Diamond Shoal" Lightship, off the coast of N. Carolina, U.S.A.

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any smell of oil clinging in the air as is so often found with machinery of this sort.

But perhaps the most fascinating parts of a lighthouse lantern are the prism reflectors. Imagine a triangular prism of undeterminate length wound round and round and round in a huge coil. That is how each side of the lantern is composed, and the result is that the strong rays of light are focussed into one brilliant central core which flashes out into miles of darkness. Each side of the lantern has such a core, and it is according to the disposition of the sides that the flashes of light are regulated. Each lightship has its own system of flashes so that any ship passing within its range can tell by the time of the flashes what lightship she is passing, and therefore what navigation dangers to be ware of. The movement is regulated automatically by clockwork which is wound up by weights and further there is attached a mechanism which rings a bell to warn the minder when the spring is running down.

The Wireless Apparatus on the "Tongue" Lightship.

When we put off again into the jolly-boat for the ship we had left one of our members on the "Gunfleet," but were recruited by another. This is the routine which is usually carried out. Each member of the station, whether it be lighthouse or lightship, remains on board for two months and then is given shore duty for one. This is a necessary provision, for it enables the man to see something of his relatives and home, or he would otherwise be condemned to a life of solitude which would out-Selkirk that great hero of solitude himself. When ashore there is sufficient work in the stores and on the relief-ship to keep the men "on leave" employed, but their evenings and Sundays are at their own disposal and, as can well be imagined, the time ashore is a time to be looked forward to and to be dwelt upon during the two months spent aboard.

From the "Gunfleet" we journeyed to the "Sunk," a distance of something over ten miles, though to the inexperienced mariner it seems much more for no land is visible, as the Naze, which is the nearest point, is about twelve miles away. As the sea was calm the relief-ship was able to draw alongside the "Sunk," and this meant a saving of over an hour in the transferring of the cargo.

The feature of the "Sunk" is the Marconi installation which links the vessel with the North Foreland. The installation was in charge of a member of the crew, and it speaks volumes for the intelligence of the men engaged in this service that they are able to manipulate the delicate instruments with accuracy and skill. The "Sunk's" "Sparks" was quite equal to all technical terms and details. Three times, he said, he

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The "Sunk" Lightship, which maintains wireless communication with North Foreland.

had sent the S.O.S. message, and in each case it had resulted in successful rescue, and this is a very good record for a station which was only installed in 1910. The apparatus is fitted up in the master's cabin, for at the time the "Sunk" was built wireless telegraphy and its installation never entered into the scheme of things and so was not given a special place in the ship. As far as the effective working of the station is concerned this is no disadvantage, but it is a little trying for the skipper, who is liable at all times to be called up even when he is off duty. As a continuous wireless watch is unnecessary, the hours for calling up the "Sunk" are eleven, three and seven, unless a previous arrangement has been entered into. Such arrangements are not infrequent, as they afford excellent opportunities for engaging in experimental work and practice. On this particular day it had been arranged that the "Sunk" should communicate with the "Dudgeon," another lightship also fitted with wireless, which is stationed off the Goodwin Sands. The operator was expecting a call at 4 o'clock in the afternoon when the general work of the day would be done and he could give himself up to this part of his work, which was also his hobby; at the same time he gains some little advantage by his energy, for he is allowed twopence an hour extra pay all the time he is transmitting or receiving. Such time is indicated on an automatic recorder which is forwarded at due intervals to Trinity House, in order that his account may be checked up.

But now the signal was given for us to board the relief-ship as the relief work was complete. A hasty scramble on board, the throb of the engines as they restarted, a call of "Let go there!" the dip of the Trinity House ensigns at the stern, and we were once more standing out to sea. Then came a long sea journey of over thirty miles to the "Outer Gabbard," the loneliest of the lightships off this part of the coast. It is placed to mark a ridge of sandbanks, which before the time of such safeguards was the scene of many a wreck. It could be sighted a long way off, its mainmast carrying the lantern surmounted by a skeleton cone. This was the sign of the "Outer Gabbard," for just as each lightship's lantern-flashes mark its identity so these cones serve the same purpose by day. The "Sunk" was surmounted with a skeleton sphere and the "Shipwash," the next lightship we were to visit had, if I remember rightly, a cylinder. Should the lightship come adrift these signs are taken down, so that the derelict vessel may not falsify the bearings of any passing ship. By one other means these ships can announce themselves, and that is the syren, for each apparatus has a different note and the blast is timed to go off at different prescribed times.

But the journey to the "Outer Gabbard" gave me time to talk to the men that we had taken off the vessels we had visited. At first they were a little nervous, but the uneventful life on the desolate sea is sufficient to account for this. After an unbroken solitude of a month the calling of a relief-ship is something of an event, while the presence of a stranger

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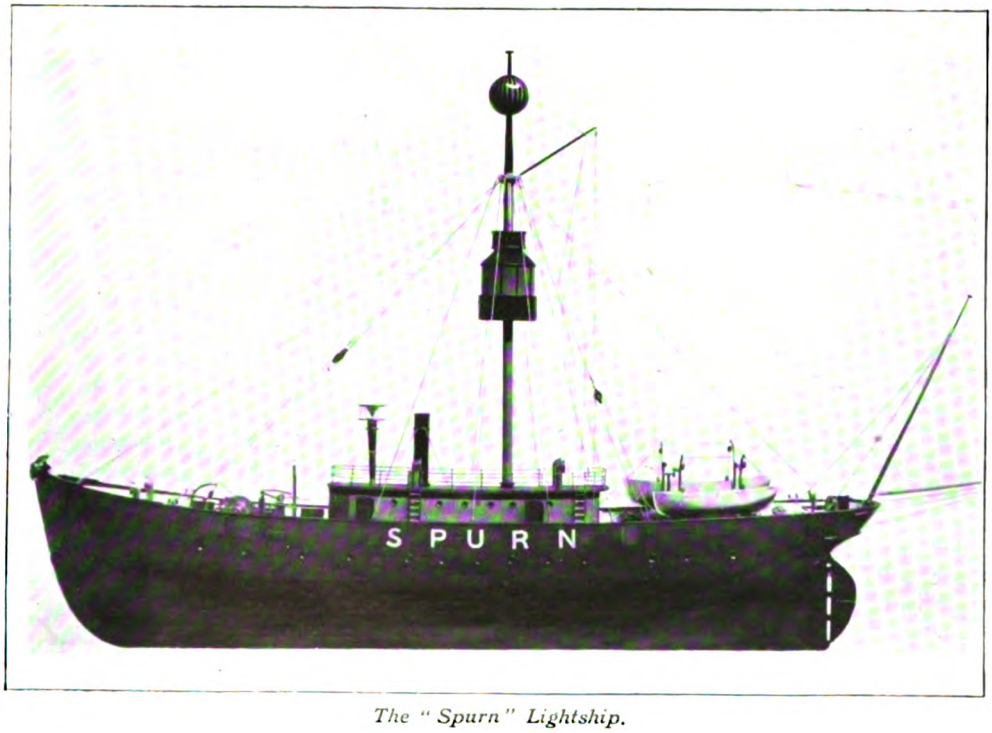
on a ship makes it an event of awful moment. Nevertheless, a cigarette or a joke soon dispelled the reserve, and when the men found they had an interested listener they were quite willing to tell their experiences. All of them liked the life, and many of them had hobbies which were of absorbing interest to the individual. In one particular case the man had taken up the work of a coppersmith, another was a carpenter of no mean order and often his talent had been put to very good use on his ship. Music, too, finds devotees even on the ocean wave, and one of the men whom we brought out to resume his work on the lightship carried with him as chief of his impedimenta a mandoline — the musical season was about to open on his ship.

The "Outer Gabbard" was particularly interesting on account of its syren, which is of enormous power. It possesses three funnels pointing away from the land to three points of the compass, and when it is working each gives a phenomenal blast so that vessels coming in any direction can hear and take their bearings. It is worked in conjunction with the lantern and, as has been mentioned before, gives its note at definite intervals. This is regulated by clockwork apparatus similar to the lantern; so, too, is the syren within the horn, which, by revolving at a certain speed, gives the required note. It is very easy with extra pressure to cause the revolutions to increase, and this, of course, pitches the note higher, so that if the mechanism were badly regulated any passing vessel would be unable to distinguish the note as belonging to the "Outer Gabbard." On a small central pivot, which revolves with the revolutions of the syren inside the megaphones, the engineer attached a chronometer and the power was switched on. Instantly came a deafening blast which made the ship quiver and seemed to batter in the drum of an unaccustomed ear. The pivot sped round at a terrific rate. It should have made seven hundred revolutions, instead it approached nearer eight hundred; that meant that the note was tuned too high, so by mysterious proddings and pokings, screwings and unscrewings, the pressure was released till the right number of revolutions was indicated. The men on board are quite accustomed to



The "Spurn" Lightship.

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the deafening sound, in fact they prefer the noise to silence, for when the signal is blowing they get twopence an hour extra. Just as in the case of the wireless, the time that the fog-horn is working is registered automatically and payment assessed by the central office. The men tell a tale of one old seaman, "Charlie," who was unable to read and write and was on board a lightship. At one time he happened to be near a petty clerk who was making up the account of his vessel and heard that worthy mention something about "twopence discount in the shilling, how much for one pound's worth of goods?" "Three and fourpence," replied Charlie promptly, and his companions, who were always chaffing him on his illiteracy, were astounded. It was some time before the phenomena was explained, and then Charlie himself revealed the secret. He had learned by experience that if the fog-horn were blowing for twenty hours he would get three and fourpence extra pay, he knew that the rate was twopence an hour, so twenty twopences were three and fourpence. That he had by heart, and when the question cropped up he was able to answer it off the reel.

But an interesting little incident took place on our departure from the "Outer Gabbard." On this occasion the master was quitting his lightship for good and all, for his sixty-five years of active life were completed, and was saying good-bye to marine service. He felt a little upset at his going, for the giving up of the old routine would mean such a break in his life. But he was not allowed to give way to his feelings, for his comrades contrived to prove to him that he was the envied of his fellows and kept up a running conversation of chaff until the vessels were too far away for hearing. "See you in a new 'at in the park," one of them shouted as a last send off, and the old man replied by waving his sailor's cap in the air. All the men seem to be very chummy, and this is as it should be considering they spend so long in each other's company with no outside interests. They all have nicknames, and often a man never knows his fellow by his surname and only as "Bob" or "Gunnie" or "Silver," or some such designation which the possessor has been dubbed by some wag of the crew.

The last lightship we touched at was the "Shipwash," which communicates with Orfordness by telephone. The cable is fixed to her bows and runs through a central gangway to the master's cabin, but the interesting part about its installation is the elaborate arrangement for insuring proper working connection. A lightship is an unstable thing at the best of times, at the worst it is a veritable flotsam, and a gale would soon cause the cable to snap if the ship were not anchored down particularly safely. This has been done, however, and 1,380 yards of chain cable have been attached to the hull. Four separate lengths are united on a hollow swivel through the centre of which the telephone cable passes. The lengths of the chain cable are stretched to the four points of the compass, so that the vessel is as far as it can be made immovable. But the tension on the chains is enormous. The motion of the waves causes them to rub together and bump on the sand, with the result that before long the oval links of quite a new chain will become circular under the strain. In time, of course, these links wear out, and every three years there is the whole paraphernalia of chain renewal to be gone through again. Even this, however, cannot insure the ship being stationary, and it has been known to lurch so that the telephone cable has broken. That is a terrible *débâcle*, for the wire, in breaking, springs back and rolls together in coils and, as a consequence, when the repairing ship comes along to make good the damage, prolonged preliminaries are necessary in order to find the broken end of the wire. The conditions being so it seems hardly likely that any more telephone systems will be installed, for wireless is infinitely cheaper and infinitely more reliable. Indeed, it seems that when the time comes that all lightships are equipped with wireless, the fortunate crews who will then be engaged on this important duty of safeguarding navigation will not be able to realise the time when they were absolutely cut off from the world, or when it was a ticklish business to communicate to shore, with the chances ten to one that in dirty weather they would not be able to communicate at all. Wireless bids fair to revolutionise the life on board a lightship, for it will bring the voice of the world to these present solitudes, where now the only cry is that of the sea-gull, and the only action, outside the ship, is the movement of the sea.

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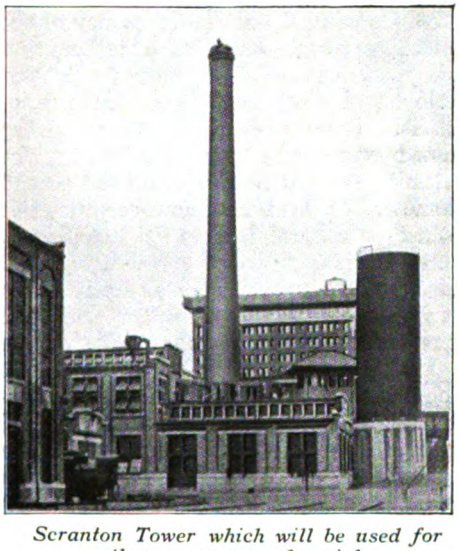
Railways of the Future

An Experiment with Wireless Telegraphy

WE are now able to give our readers some additional information regarding the experiment with wireless telegraphy which, as we announced recently, is being made on the trains of the Lackawanna Railroad. The railway company have entered into a contract with the American Marconi Company for the installation of a 2-kw. high-frequency spark set at Scranton, Pa., and another at Binghampton, N.Y., and for one 1-kw. set to be



Scranton Tower which will be used for the suspension of aerial.

installed in a special compartment built into one of the day coaches of the Lackawanna.

A horizontal antenna will be constructed over the entire train, and the immediate experiments will be confined to the maintenance of communication between Scranton and Binghampton and the moving train. This work will be mainly experimental, but successful results will be followed by the erection of wireless apparatus at Elmira, Buffalo, and Hoboken.

At Scranton, on the 175-feet brick stack at the works of the railway company, a steeplejack has placed a pulley and halyards from the top of which will be suspended an antenna some 700 feet long, terminating in the Scranton depot building of the Delaware, Lackawanna Railroad. A similar antenna is being erected at Binghampton.

It is hoped that the success of these experiments will demonstrate the practicability of the scheme.

Mr. W. L. Foley, Superintendent of Telegraphs, is confident of the success of the enterprise. He states that, in common with all other railroad men who have had to do with telegraph equipment, he had been continually impressed, not only with the great cost of keeping up the old style of line, but also with the fact that it is usually out of commission during the times when it is most needed, as in cases of storm and flood. He realised also the limitations of the present service, especially in relation to safety. "Every old railroad operator," he added, "knows by experience the nightmare of the man at the key—two trains heading for each other between stations and no means of stopping them; sometimes this may result from carelessness, but often it comes about in a way that no man can foresee or forestall, and in such conditions wireless will prove invaluable, for by its use the despatcher will be able to catch a train anywhere on the road."

Superintendent Frank Cizek, of the Syracuse and Utica divisions, is as confident as Mr. Foley of the success of the undertaking. He gives the following description of the apparatus which is now being tested.

"The power will be supplied by a special motor generator set, developing 100 volts at 500 cycles and capable of two kilowatts when using an extreme wave-length of 800 meters.

"In order to maintain communication with rapidly moving trains, tuning apparatus of the most delicate construction is required to enable the operator continuously to adjust to required wave-length without interfering with his regular duties.

"The operator is equipped with a double receiver, similar to those used by telephone operators, except that they are wound to a resistance of 3,000 ohms instead of 75. For transmission he uses a key similar to the ordinary telegraph key, except that it is much heavier. The current passing through a wireless key is so great that it would melt an ordinary telegraph key in a few seconds."

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SCIENTIFIC NOTES

CURRENT RUSHES IN TRANSFORMER CIRCUITS.—It is well known, and sometimes painfully brought home, that at the closing of a transformer circuit there may be produced sudden rushes of current which reach values many times that of the normal current. When the induction is high and the saturation weak these rushes are particularly violent. It is equally well known that the rush can be diminished by the introduction of resistance in the circuit at the moment of closing. M. Rogowski, in the *Archiven für Elektrotechnik*, has given an analysis of the phenomenon, and has established a differential equation for it. This equation is difficult to solve because the intensity of the current and the induction are not connected by linear expressions. To obviate this difficulty, and to obtain an analytical expression which agrees sufficiently well with the curve of magnetisation and at the same time permits the integration of the differential equation, M. Rogowski replaces the curve by a broken line composed of three parts, the first corresponding to the straight ascending branch, the second to the knee of the curve, and the third to the region of saturation. For each of these three parts there is an approximate proportionality between the value of field intensity—that is to say, the number of ampère turns per centimetre—and the differences of the induction at the beginning and at the end of that particular part. The author determines the coefficients of proportionality and the values of induction by the help of a magnetisation curve, and thus establishes three separate differential equations, each of which represents the influence of induction in the corresponding part. These equations can easily be solved. It is seen that even for small values of resistance the current rush decreases rapidly. For very small values of the ratio between the ohmic drop and the induced electro-motive force the influence of the remanent magnetism is eliminated.

* * *

THE RECIPROCAL EFFECT OF TWO NEIGHBOURING AERIALS.—M. C. Tissot contributes an exceedingly interesting paper on this subject to the *Journal* of the Académie des Sciences, in which he recalls certain results obtained some years ago and deals with them very fully. The original results were obtained in some experiments carried out for the purpose of tracing the resonance-curve of a direct-coupled transmitting aerial. The energy received was measured by a bolometer connected to a receiving aerial A, and this aerial A was varied in length (presumably in such a manner that its effective height remained constant) so as to be in and out of tune with the transmitted wave. In order to keep a control on the constancy of the emitted waves, in the first experiments a fixed receiving aerial B, near to A, was employed with a second bolometer in series with it. B was, of course, tuned to the emitted wave, and any variation in the transmitter would be shown on the second bolometer. It was found, however, that this method of control had to be abandoned, owing to the fact that the bolometer of B underwent variations *quite independent of variations in the transmitter* and due entirely to the changes in length of the neighbouring aerial A. It was noticed that when the aerials A and B were both single-wire aerials the energy absorbed by the fixed aerial B reached a minimum when the neighbouring aerial A was brought into resonance with the transmitted wave; but —and here comes the interesting phenomenon—when the aerial A was *multiple* the minimum of energy received by the single-wire aerial B corresponded to a certain decrease of the aerial A to a tune less than that of the transmitted wave.

* * *

The first result (*i.e.*, with single-wire aerials) is easily explained when we remember that the aerial A drains for its own advantage a portion of the energy of the field which is the greater the nearer A is to resonance; and the amount of energy thus absorbed by A reduces to a corresponding extent the energy received by B. But this is only a rough way of looking at the matter. The phenomenon depends, actually, on the respective value of the quantity of energy

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taken up by each of the aerials and on the modification which each one produces on the primitive field of their own radiation.

* * *

Now the radiation of an aerial (and reciprocally its *absorbing power*) is intimately connected to its electrical dimensions. It depends particularly on the factor $1/L.\frac{l}{\rho}$ (where L is the inductance, l the length, and ρ the radius vector of the field), which enters into the expression for the field in the immediate neighbourhood of a linear oscillator. It is because this factor has a higher value for multiple-wire aerial than for a single-wire aerial that a multiple aerial takes up more energy from the field produced by in-coming waves than a simple aerial. This has been shown by M. Tissot elsewhere.

The lack of symmetry indicated by the above-named experiments becomes clearly comprehensible by a consideration of the above factor. When the aerial A is a multiple one, so that the factor has an important influence, the effect of throwing A out of tune with the in-coming waves depends on the nature of the "out-of-tune"-ness or a-syntony, in the following manner :—

1. When the a-syntony is in the direction *above* the resonance-point, so that the actual length of A is *longer* than that corresponding to the wave of the transmitter, it produces two effects tending to make the variable system *less* absorbent ; in the first place it puts the aerial out of resonance, and in the second place it increases the ratio l/ρ.

(2) When the a-syntony is in the direction *below* the resonance-point, so that the length of A is *shorter* than that corresponding to the wave of the transmitter, it produces two effects : in the first place it decreases the absorptive power by putting the aerial out of resonance, but in the second place it decreases it by diminishing the ratio l/ρ.

It is clear that in (1) the two effects are additive and in (2) they are in opposition, with the result of dis-symmetry, so that even with two identical receiving aerials the minimum of reception for the aerial of fixed tune would not occur exactly when the variable aerial comes into resonance with the transmitted wave, but when that aerial is slightly out of tune in the direction of too short a wave-length.*

* * *

In the case where the tune of the aerial is modified by the introduction of inductance coils, instead of by varying the actual length of the aerial, we are led to an analogous interpretation which becomes simplified by the use of the expression "radiation resistance" of the aerial. (A definition of this expression was given in the "Questions and Answers" column of THE MARCONIGRAPH of January, 1913.) It can be shown that the disturbance produced in the incident field by a receiving aerial (of negligible ohmic resistance) is inversely proportional to the expression

$$\sqrt{1 + \left[\frac{L\omega}{R}\left(1 - \frac{\omega_0^2}{\omega^2}\right)\right]^2}$$

where ω_0 represents the incident wave-frequency, ω the natural frequency of the aerial affected, L the self-inductance of the receptive system, and R_e its Radiation resistance.

R_e varies in proportion to the square of the ratio l/λ of the actual length of the aerial to the wave-length of the system. Moreover, when an aerial is modified by the introduction of a coil of self-inductance,

$L\omega$ varies as $\sqrt{L}$

In increasing the self-inductance (a-syntony in the direction of too *long* a wave-length) both the expressions

$$\left(1 - \frac{\omega_0^2}{\omega^2}\right) \text{ and } L\omega/R_e$$

are increased. In decreasing the self-inductance (a-syntony in the direction of too *short* a wave-length), the expression

$$\left(1 - \frac{\omega_0^2}{\omega^2}\right) \text{ is increased, but } L\omega/R_e$$

is decreased. The result therefore is a dis-symmetry similar to that described above. In order, however, for the dis-symmetry to become clearly apparent, it is necessary that in adjusting the respective self-inductances or tuning-coils a variation of $L\omega/R_e$ should be produced which is greater for one aerial than for the other. Such is the case when one of the aerials is multiple and the other simple.

* This conclusion, though fitting in with the observed results, seems hardly to be justified by the argument as it stands ; for although the two effects of a-syntony on the short side are opposed to each other, they would still have a resultant tending to decrease the absorptive power below its value at syntony, *unless* the increasing effect is equal to or greater than the decreasing effect. Since the decreasing effect of a-syntony is a matter of decrement, it would appear that the damping of the incident wave would have an influence on the result obtained.

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The British Association

Birmingham Meeting

SIR OLIVER LODGE ON "CONTINUITY." RADIO-TELEGRAPHIC INVESTIGATIONS. ATMOSPHERIC CONDITIONS AND STRENGTH OF SIGNALS. ELECTRO-MAGNETIC WAVES. RADIATION.

AT this time of the day it is hardly necessary to say anything concerning the place which the British Association has gained for itself in the world of science. It is recognised as the leading deliberative body of its kind, and its meetings are attended by savants from all parts of the world, who rejoice in so excellent an opportunity of acquainting themselves with the latest movements in modern thought, and are proud to bring offerings to the feast of wisdom that the gathering invariably provides. Since its inception the Association has vastly increased the scope of influence of its operations, and this year's meeting, which opened at Birmingham on September 10th, was one of the most interesting in its history. Very appropriately, Sir Oliver Lodge, Principal of Birmingham University, prominent among the most broad-minded and enterprising of men of science, was President, and his inaugural discourse had excited in anticipation no small amount of speculation, for although Sir Oliver is widely known as an eminent physicist, his name is no less familiar as that of a convinced and avowed believer in the value of psychical research. He is a past President of the Society for Psychical Research, and this fact, coupled with the sceptical attitude of many men of science towards psychical phenomena, piqued the curiosity of the public as to the line which the new President would adopt and heightened interest in the occasion.

The main subject of the address, however, was concerned with other matters, though the President did not shrink towards the close of his remarks from a confession of faith in the utility of psychical research; and in a notable passage he declared his conviction "that memory and affection are not limited to that association with matter by which alone they can manifest themselves here and now, and that personality persists beyond bodily death."

Whilst the address well maintained the high traditions of the occasion, it contained no record or forecast of epoch-making discoveries in the realm of physics or invention, as so many of its predecessors have done; it was not even, as others have been, a brilliant exposition of the latest advances which pure or applied science have achieved. Rather was it in the nature of an admonition to students and savants as to the limitations which available methods and means of research impose upon humanity in its investigation of the greatest problems of life; a warning against dogmatism and against the too ready negation of beliefs and speculations, the demonstration of which is outside the realm of scientific investigation and experiment.

TENDENCIES OF THE AGE.

Sir Oliver devoted himself in the main to an examination of the principle of continuity. His argument was that a marked feature of the present scientific era is the discovery of and interest in various kinds of atomism, so that continuity seems in danger of being lost sight of. Other tendencies are towards comprehensive negative generalisations from a limited point of view, and to take refuge in rather vague forms of statement and to shrink from closer examination of the puzzling and the obscure; while yet another is to deny the existence of anything which makes no appeal to the organs of sense, and no ready response to experiment.

Against these tendencies Sir Oliver contended. He urged a belief in ultimate continuity as essential to science; he regarded scientific concentration as an inadequate basis for philosophic generalisa-

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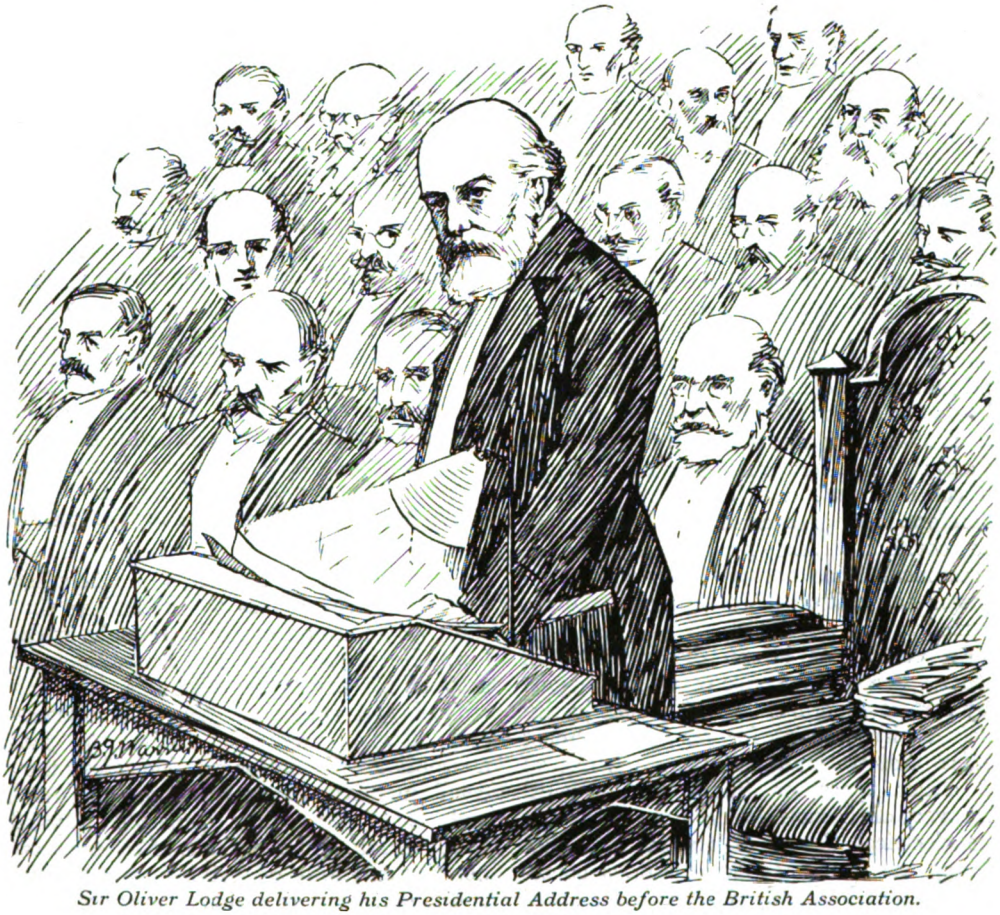
tion, he believed that obscure phenomena might be expressed simply if properly faced, and he pointed out that the non-appearance of anything perfectly uniform and omnipresent was only what should be expected, and was no argument against its real substantial existence.

Proceeding to unfold his argument, he said that there was a critical examination of scientific foundations generally going on, and a kind of philosophic scepticism was in the ascendant, resulting in a mistrust of purely intellectual processes, and in a recognition of the limited scope of science. For the nature of man was a large thing, and intellect only a part of it : a recent part, too, which therefore necessarily, though not consciously, suffered from some of the defects of newness and crudity, and should refrain from imagining itself the whole—perhaps it was not even the best part—of human nature. Not by philosophers only, but by scientific men also, ancient postulates were being torn up by the roots.



Sir Oliver Lodge delivering his Presidential Address before the British Association.

THE UNIT OF MATTER.

He urged that we should remain with, or go back to, Newton. He saw no reason against retaining all Newton's laws, discarding nothing, but supplementing them in the light of further knowledge. On the modern sceptical attitude he quoted Poincaré. If, he continued, they had to summarise the main trend of physical controversy at present, he felt inclined to urge that it largely turned on the question as to which way ultimate victory lay in the fight between continuity and discontinuity. The

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modern tendency was to emphasise the discontinuous and atomic character of everything. Matter had long been atomic in the same sense as anthropology was atomic.

The unit of matter was the atom as the unit of humanity was the individual. Whether man or woman or children, they could be counted as so many "souls," and atoms of matter counted too. Electricity itself — *i.e.*, electric charge — strangely enough had proved itself to be atomic. Even magnetism had been suspected of being atomic, and biology might be said to be becoming atomic. So far from nature not making jumps, it became doubtful if she did anything else. Her hitherto placid course, more closely examined, seemed to look like a kind of steeplechase. Yet undoubtedly continuity was the backbone of evolution, as taught by all biologists. He himself was an upholder of ultimate continuity, and a believer in the ether of space.

In his view we had learnt as follows: The ether is the universal connecting medium which binds the universe together and makes it a coherent whole, instead of a chaotic collection of independent isolated fragments. It is the vehicle of transmission of all manner of force, from gravitation down to cohesion and chemical affinity; it is, therefore, the storehouse of potential energy. He could not imagine the exertion of mechanical force across empty space, no matter how minute; a continuous medium seemed to him essential

He could not admit discontinuity in either space or time, nor could he imagine any sort of experiment which would justify such a hypothesis, for surely we must realise that we knew nothing experimental of either space or time. The physical discovery of the twentieth century so far was the electrical theory of matter, and that theory was bound to have curious consequences; and already it had contributed to some uprooting and uncertainty. But the theory was a positive achievement, and had positive results. The ether of space was at least the great engine of continuity. It might be much more, for without it there could hardly be a material universe at all. And yet it was possible for people to deny its existence, because it was unrelated to any of our senses except sight, and to that only in an indirect and not easily recognised fashion.

SCIENTISTS AND SUPERSTITION.

The President passed on to consider the question of vitalism as applied to biology, and while repudiating the use of vital force as a term implying inconsistency with the laws of chemistry and physics, drew attention to the limitations of the science, and argued that while there was plenty of physics and chemistry and mechanics about every vital action for complete understanding of it something beyond physics and chemistry was needed. While justifying the hostility of scientific men to superstition, he pointed out that the term might occasionally be applied to practices of which the theory was unknown. Matter was what appealed to our senses here and now; materialism was appropriate to the material world, but everything beyond that belonged to another region, and must be reached by other methods. To explain the psychical in terms of physics and chemistry was simply impossible. He protested against the exclusion of life and mind from science, and held that if men of science dogmatised in a negative direction and said they could reduce everything to physics and chemistry, they gibbeted themselves as ludicrously narrow pedants and were falling far short of the richness and fulness of the human birthright.

Sir Oliver Lodge devoted the concluding portion of his address to contending that the psychic region could be brought under law. He recorded his own conviction and that of his co-workers that the facts examined had convinced him that memory and affection were not limited to that association with matter by which alone they could manifest themselves here and now, and that personality persisted beyond bodily death. The methods of science were not the only way of arriving at the truth, and it could not be seriously supposed that Truth was arrived at on this planet only a few centuries ago. Genuine religion had its roots deep down in the heart of humanity and in the reality of things, and it was not surprising that the methods of science failed to grasp it. The actions of the Deity made no appeal to any special sense, only a universal appeal, and the methods of science were incompetent to detect complete uniformity.

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RADIO COMMITTEE'S REPORT

The work of the various sections of the Association is to some extent overshadowed in the popular mind by the Presidential address; nevertheless, a good deal of quiet and unostentatious work for the encouragement of research and the extension of scientific knowledge is carried out. At the Dundee meeting last year a committee consisting of Sir Oliver Lodge (*Chairman*), Dr. W. H. Eccles (*Secretary*), Mr. Sidney G. Brown, Dr. Erskine Murray, Professors J. A. Fleming, G. W. O. Howe, and H. M. Macdonald, Captain H. Riall Sankey, and Professor Silvanus Thompson was appointed for the purpose of conducting radiotelegraphic investigations.

At a meeting held on June 13th, 1913, the Committee came to the conclusion that the most urgent and most profitable work they could promote was the investigation of the following large-scale phenomena :—

1. The influence of sunrise and sunset, of daylight and darkness, and of meteorological conditions, on the propagation of electric waves over long distances;
2. The origin and the laws of "strays" —*i.e.*, natural electric waves.

These are subjects which seem particularly suitable for the British Association, since they are such as cannot be efficiently pursued by unco-ordinated individual effort.

In order to promote the necessary widespread observations, the Committee propose to draw up a simple scheme of instructions which will be circulated to amateurs throughout this country, and also, with the permission of the companies concerned, to operators on ships. These instructions would include directions for simultaneous observations of, for example, the strength of the time-signals from such stations as the Eiffel Tower, and the average strength and frequency of strays. The observations would subsequently be classified and reduced by this Committee; and it is felt that this work would open up at once an almost unexplored, and exceedingly promising, branch of research—one which cannot be entered upon in any other way. It is, of course, essential that the work should be carried out over a very large area and by very numerous observers: and after full consideration of this fact the Committee resolved to apply for a grant of £200 to enable the work to be started in a thorough manner.

INFLUENCE OF THE ATMOSPHERE UPON SIGNALS.

In Section G, Professor E. W. Marchant read a paper on the "Effect of Atmospheric Conditions on the Strength of Signals received at Liverpool from Paris and some other place, together with an account of the Diurnal Variations in the Energy received." Measurements had been made over a considerable period of time, but those described by Professor Marchant dealt mainly with observations during the month of July. The most accurate observations had been obtained with signals sent out by the observatory at the Eiffel Tower at 10.45 a.m. and 11.45 p.m. The method adopted in the earlier tests was to use a "Perikon" detector in series with galvanometer and telephones, the measurement of strength being made by the cumulative deflection due to a series of known signals. This method was not found satisfactory with the Paris signals for which the antenna current used was known, and in the later tests an Einthoven String Galvanometer was employed by which the strength of signal for each individual spark at Paris could be observed to within ± 5 per cent. The results obtained show that there is a maximum variation from 0·6 to 1·3 in the strength of the signals received on different days in the same month; the average strength of signal being assumed to be 1·1, and that the current received on a fine, clear night is about 1·7 times as strong as that received in the daytime.

Although no certain relationship can yet be regarded as established between the strength of a signal and the weather conditions at the sending and receiving stations, so far observation has shown that rain in Paris always corresponds with a diminution in strength of received signal. In one case, with a wind of 6 metres per second velocity, blowing in a N.W. direction, the signal-strength fell to half its normal value. The most favourable condition for signalling appears to be a cloudy sky at both sending and receiving stations, the signals being weaker when the sky is clear or covered with light clouds. Rain at the receiving station appears to have a comparatively small influence on the strength of the received signals.

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The result of a set of special signals sent from the Eiffel Tower on the evening of Saturday, July 26th, 1913 (by the courteous arrangement of Comm. Ferrié), at intervals of 30 minutes, between 7 and 10 p.m. (which includes the time of sunset), shows that the increase in strength of night signals occurs just after sunset, there being a sudden increase in strength of about 70 per cent. This change is quite sudden, there being comparatively little alteration in signal-strength until the sun has set and no perceptible increase in strength afterwards. There appears to be some evidence that signals are slightly stronger just after sunset than during normal night conditions.

ELECTRO-MAGNETIC WAVES.

In a paper dealing with the "Nature of the Electro-magnetic Waves employed in Radio-telegraphy and the Mode of their Propagation," Professor G. W. O. Howe said:

A very clear conception of the nature of the electro-magnetic waves employed in radio-telegraphy can be obtained by considering those electro-magnetic waves which exist in the space between the two conductors of a single-phase transmission line. If the conductors are flat, parallel strips, close together, and connected at the sending end to the terminals of an alternator, there is a certain value of the non-inductive load at the receiving end which will absorb the arriving energy without any reflection. Under these conditions the current and voltage are in phase all along the line, and the same is true if the line is assumed to be of infinite length. Line resistance and leakage are assumed to be negligible. It follows from this that the electric and magnetic fields at any point have their maximum values at the same moment. Instead of two parallel strips transmitting energy in one direction, two parallel discs of infinite extent can be imagined with the alternating P.D. applied between their centres. Energy would then be transmitted radially in all directions in the plane between the discs. The earth could take the place of the lower disc, while the upper one could be represented by a conducting horizontal plane some distance above the earth. The waves produced would be truly cylindrical, whereas those employed in radio-telegraphy are spherical. If, now, the upper disc is replaced by an inverted conducting cone of infinite extent, with its apex almost in contact with the earth, the alternating P.D. being applied between the apex and the earth, the electro-magnetic waves will be almost identical with those employed in radio-telegraphy and will vary in the same way with the distance from the sending station. This imaginary multi-directional transmission line, consisting of a lower plane (the earth) and an inverted cone, lends itself to simple calculation, because, like an ordinary transmission line, and unlike the two parallel discs, it has a constant inductance and capacity per mile. It can be shown that if the angle between the cone and the earth is 70 degrees, the relations between the magnetic and electric fields near the earth's surface and the total energy radiated are identical with those existing in the ordinary radio-telegraphic wave. As in the transmission line already considered, the current and P.D. will be in phase at every point, and therefore, contrary to the usually accepted view, the horizontal magnetic field and the vertical electric field due to a sending antenna are not 90 degrees out of phase, but are approximately in phase, except in the immediate neighbourhood of the antenna. This also follows from the fundamental equations of a progressive, as distinct from a stationary, electro-magnetic wave.

DR. ECCLES' THEORY.

Dr. W. H. Eccles, in a paper on "Atmospheric Refraction and Absorption as Affecting Transmission in Wireless Telegraphy," said that the fact that signals might travel at night over very long distances suggested the influence of reflection rather than refraction, while in the daytime the indication was that those signals of great wave-length travelled best on a refraction basis. He developed the theory that he has brought forward elsewhere, that as a result of the ionisation in the upper layers of the atmosphere the rays which started horizontally followed a curved path with their concavity towards the earth. He indicated some lines on which this theory had been developed.

Professor J. A. Fleming, in opening the discussion on the three papers abstracted above, emphasised the need for research. He did not consider that Dr. Eccles's theory

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although a great deal was to be said for it, explained everything, and inclined to the view that there was some effect produced by waves which travelled through the earth. He strongly advocated the appointment of a Radio-Telegraphic Committee to investigate the problem.

Professor Nicholson held that the atmosphere took an important part in conducting the waves, and supported Dr. Eccles's theory. Mr. Rivers Moore pleaded for the co-operation of amateur wireless telegraphists, who would be able to undertake researches that were not possible in the case of postal operators, owing to the exigencies of the public service. Professor E. Wilson argued in favour of a more thorough organisation of experimental work, and Dr. Eccles, speaking on behalf of the Radio-Telegraphic Committee of the Association, said that the work of organising amateurs and others was already in hand, and he hoped that the scheme would be in working order early next year.

Contacts between Electrical Conductors.

In Section A, Dr. W. H. Eccles read a paper entitled: "Contacts between Electrical Conductors," of which the following is an abstract.

When a current is passed across a "loose contact" the relation between the applied electro-motive force and the current produced is, in general, not a linear one, and no sufficient explanation of the observed phenomena has hitherto been offered. The present author investigates whether the behaviour of contacts can be accounted for by purely thermal actions in the matter near the contact. The Joule, the Peltier, and the Thomson effects will all play a part, and the alterations of resistivity with temperature, as well as alterations of the geometrical configuration of the surfaces in contact, caused by thermal expansion, ought all to be taken into account. These thermal effects are, of course, most noticeable in contacts between bad conductors of electricity and of heat, as, *e.g.*, the natural crystalline oxides and sulphides.

It is advantageous to separate contacts into two classes: First, those between like substances; second, those between unlike substances. In the first class there is in general no thermoelectric action, and the non-linearity of the relation between applied e.m.f. and current is mainly due to resistivity changes produced by Joulean heating. In the second class there is in general some thermoelectric action imposed on the resistivity-temperature phenomenon; and in the case of the crystalline substances mentioned the thermoelectric actions may be the more important.

For the first class, theory yields a cubic equation connecting e.m.f. and current. Experiments are adduced by the author which show that the thermal explanation is in many cases sufficient. In the second class, thermoelectric theory yields a quantic equation. The curve connecting e.m.f. and current takes very various shapes according to the signs and the relative magnitudes of the Peltier and Thomson coefficients in the substances forming the contact. The author has measured these coefficients in some typical substances and has thus carried out a comparison between the theoretical curves and the experimental curves of contacts between pairs of these substances. The evidence gathered in this way tends in the main to support the theory.

Radiation.

Only one more of the many interesting features of the meetings can be touched upon in the present article, that is the discussion on radiation in the Mathematical and Physical Science Section on September 12th. Some years ago Lord Rayleigh and Mr. H G. Jeans established that the law of radiation as deduced from ordinary electro-dynamics was impossible. In connection with this difficulty that had been reached, Planck made the assumption that energy could only be radiated in definite elements or units, and the history of the subject has since largely been the verification of Planck's view experimentally. In other words, there has been a growing tendency to regard energy as consisting of units or *quanta*, or what Sir J. J. Thomson has described as "pint-pots," as opposed to the older view that energy could be radiated generally without such definite units. The discussion last month showed a remarkable tendency towards reconciliation between these different views, and the attempt was made to reconcile Planck's views and the deductions made from them with the views that generally obtain as a result of

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tackling the problems in accordance with the classical laws of electro-dynamics. Mr. Jeans, in opening the discussion, drew attention to the difficulty into which physicists had been landed by attempting to explain radiation by the laws of Newton and Maxwell, and held that the tendency now was to start with the facts and attempt to get at the laws. His address was a long one, and in it he laid down the general basis on which the modern views have been established, arguing in favour of energy being transmitted by "sudden jumps" rather than by continuous undulations. Professor Lorentz (Leyden), who followed him, expressed the hope that it would be possible to explain black radiation, while adhering to the older theories of mechanics, but he emphasised that new ideas had to be introduced. There must be some kind of discontinuity, new or apparent, something that went on by jumps. He followed Planck in assuming something as a link between matter and ether, which he termed a resonator. He did not see that to abandon the ether would make matters much better, and he thought there was not much difference whether one spoke of ether or vacuum. The physicists of the sixteenth century and Lord Kelvin would not have doubted the existence of the ether. Had he done so Kelvin could never have written his well-known treatise on the duties of the ether, for a thing that did not exist could not have duties. He discussed the exact attitude which he took up on the question of *quanta* of energy, and said that it would be lamentable if one had to give up the electro-magnetic theory for the ether, the working out of which it had been the great glory of Clerk Maxwell to establish. There was general agreement with him from members of the section when he remarked in conclusion that all was still extremely difficult.

Sir Oliver Lodge interposed at this stage of the debate to emphasise that the laws of electricity inside the electron must be different from those outside of it, otherwise the system would spontaneously explode. It was obvious, he said, that nothing in the nature of finality could be reached at that meeting, and he, therefore, invited those interested to come to a symposium to be held at his house to consider the matter.

After Professor Pringsheim had discussed the subject from the experimental standpoint and Dr. Bohr had spoken, Professor Love said that he was surprised at the acceptance of the theory of *quanta* when he considered the nature of the evidence on which it was based. It had been accepted largely, he thought, because of the close agreement between the experimental results and the calculations on which they were based, but it seemed to him that there must be hundreds of thousands of formulæ that would fit the fact as well as Planck's. He hoped that the ordinary laws of electro-dynamics had not got to be supplanted by any idea like the atomicity of energy. Lord Rayleigh said that they had been in pretty deep water that morning, and that if it were a case of likes and dislikes he should like to stick to the electro-magnetic theory and avoid these "jerks." Sir Joseph Larmor asked whether the new ideas could not be reconciled with the old, or must they be content that the old views should become obsolete. The debate at any rate had shown that the classical equation for radiation in the free state could stand. As regards what happened when electrons came into collision with atoms it was very different. He reminded the audience that it was Professor Lorentz who had first pointed out that Planck's formulæ involved the atomicity of energy.

PHOTO-TELEGRAPHY

In the article which Professor Korn contributed to the September number of THE WIRELESS WORLD on the transmission of photo telegraphs and drawings by wireless telegraphy, the imprints under two of the illustrations are apt to be misleading and to produce wrong ideas concerning the results of Professor Korn's invention. The three photographs reproduced in the magazine were specimens of transmission through ordinary wires, as was stated under two of them.

Fig. 3, which is a reproduction of the portrait of the aviator M. Brindejonc de Moulinais, was a transmission through an artificial conductor; Fig. 2, which represented Colonel Mangin, was sent through a telephone line.

In bringing this correction to our notice, Professor Korn asks us to mention that the quality of wireless results in photo-telegraphy cannot yet enter into competition with that of photo telegraphic transmission through ordinary wires.

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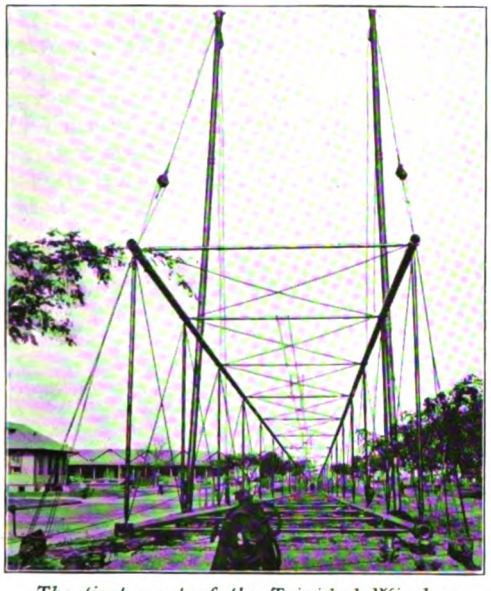
Wireless Telegraphy in Trinidad

A description of the new Government Station which has been erected on this the most important of the West Indian Islands.



The first mast of the Trinidad Wireless Station ready for hoisting.

THE equipment of a new Government wireless station is in progress at Trinidad. It is to consist of a standard Marconi 5-kilowatt station, with a guaranteed daylight range of 350 nautical miles, but this, of course, will be greatly exceeded when the conditions are favourable, and at night time the wave-length can be estimated at from anything between 600 and 2,000 metres. This is not the first station to be erected at Trinidad, but the earlier one has for some time been inadequate for the growing importance of this, the chief island of the West Indies. It is not yet decided what will happen to the old station, but it will probably be retained for purposes of communication with Tobago, another island of the West Indian group, and Trinidad's most important possession—valuable by reason of its extensive cocoa and cocoa-nut estates. The new station is erected principally for the purpose of communication with ships at sea, but it will also be in touch with the wireless stations in British Guiana, with those in North America, and the Carribean Seas.

For a long time the necessity of such a station was recognised by all who had anything to do with the place, for Trinidad is becoming not only an important centre of commerce and shipping, but it is also an increasingly popular tourist resort. Many are the visitors that flock there during the months of December, January, and February, for the climate at that time of the year is warm and healthy without being unduly hot—the temperature never goes lower than 75 during the day, while the nights are cool and refreshing. In the summer, however, things are different, for from February the temperature increases, till in June it is almost tropical. Then comes the wet season, which lasts for nearly three months, and during this time the climatic conditions are hardly pleasant. Heavy showers are frequent, and these may last from five minutes to over an hour, when the rain comes down in perfect deluges, making the streets into floods and low-lying ground into swamps. As soon as the rain is over, the sun shines out in all its brilliance, with the result that the earth literally "steams," and then is the time for malaria and the evils of the tropics.

Another fact which lends importance to Trinidad is that it is the chief depot of the Royal Mail Steam Packet Company, whose vessels make this the first call on their route to South America. Besides this, it is the junction for all shipping to the West Indian Colonies, and goods and passengers destined for St. Lucia, St. Vincent or Guiana, must first make a land here.

The presence of oil in large quantities in Trinidad had been suspected for many years, but early in the twentieth century the Government undertook a geological survey which revealed the presence of several likely borings. Three companies were immediately formed to make experiments and the sites

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Luxuriant vegetation destroying a cable.

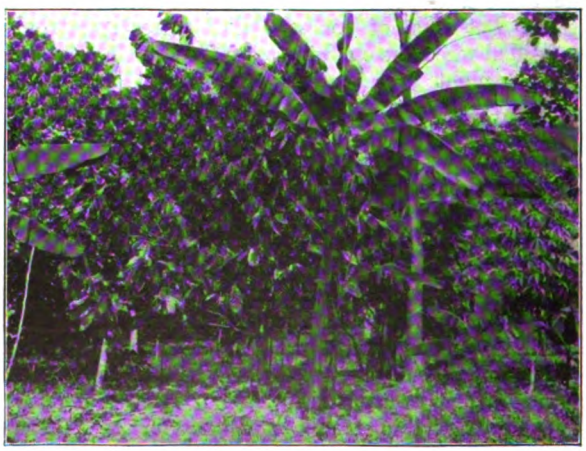
to renew their contracts, while not a few settle themselves permanently in the island, but they never mix with the native race.

Trinidad was discovered by Columbus in 1496, and it remained a Spanish possession till 1797, although its former capital, San José de Oruna, was burned by Sir Walter Raleigh in 1595. It became a British possession after its capture by the British expedition from Martinique in 1797, and it was finally acknowledged as such in 1802 by the Treaty of Amiens.

The island is remarkable for its natural beauty. To the north runs a range of high mountains,

The wonderful Asphalt Lake, Trinidad.

they have bought for their operations are situated at La Brae, Point Fortin and Guayagnayara, and the commercial exploitation of this commodity is being pushed rapidly forward. The success of Trinidad enterprise is due in a large measure to the excellent system of contract labour which is in vogue here. Under it as many as 100,000 coolies have been introduced almost exclusively from India. They are protected by vigilant inspection from all injustice, and are engaged on equitable terms for five years, then reshipped free of charge to their Indian homes. Many of them, however, often prefer



One of Trinadad's famous cocoa plantations.

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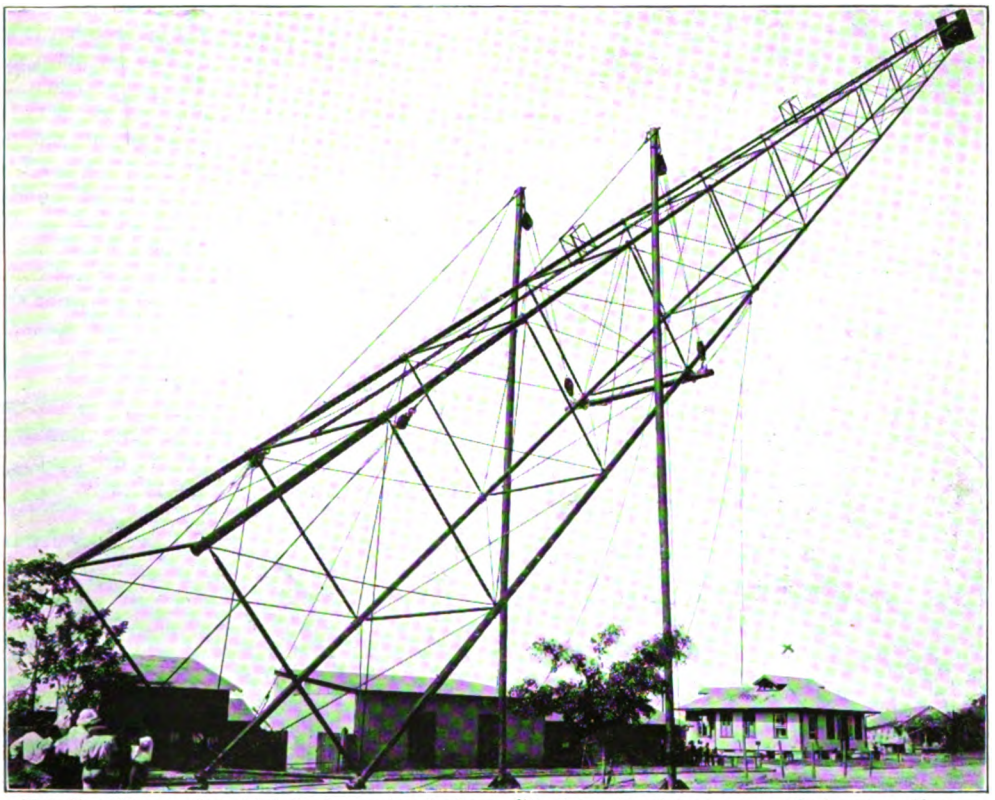
clothed with tropical vegetation, and this borders a central plain which is very fertile, bearing abundant sugar, cocoa, and cocoanut crops. Here is a description of the island by a well-known traveller: "About half-an-hour's walk from the town brings one to the banks of a beautiful river in the forest. Silk-cotton trees with tall, stately stems rising to a height of 100 feet before the lowest branch is reached, tower above the throng of bread-fruit trees, mangoes, tamarinds, bamboo, coffee and cocoa trees. The ground is covered with all kinds of ferns, with palms, grasses, and innumerable species of undergrowth, whilst masses of creepers cover even the tallest trees, climbing the trunks and spreading over the branches, then falling in festoons to the ground. Through all this wealth of gigantic vegetation the river winds, now very little more than a brook, rippling over the stones with a cool and refreshing sound, but often rising some twenty feet in a few hours and becoming a roaring torrent. Sitting on a rock at the side of the water I gazed long upon the scene before me. Some coolies were bathing in a beautiful pool at the bend of the river, their bronze colouring making a fine contrast to the green of the forest behind them. Meanwhile dragonflies of all colours are whirling about in the air and skimming over the surface of the water. Gorgeous butterflies two or three times the size of any to be seen in England flutter past incessantly. Humming-birds hardly any larger than butterflies, with plumage of a brilliant emerald green, fly from branch to branch sucking the honey from the blossoms. Little fishes innumerable are darting about in the pools."



Hoisting the mast (which had previously been fitted together) by means of strong pulleys.

But the most striking natural feature of the place is the great pitch lake of La Brae. It is a source of revenue to the Government, who receive a royalty on all the asphalt exported therefrom. The lake

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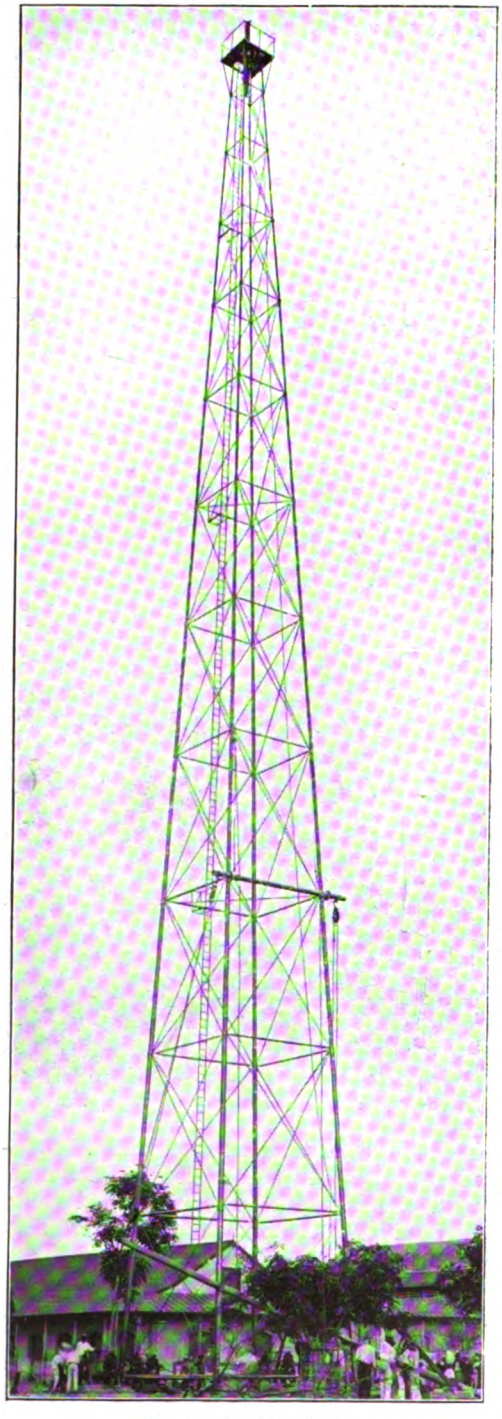

The mast in position.

itself is circular in shape, and about one mile across, with an approximate area of 100 acres. The centre is an almost liquid mass, bubbling and viscous, the latter increasing towards the edges, where the pitch is almost hard. The hot sun has the effect of somewhat softening the pitch, so that anything thrown on the surface readily makes an impression. This surface is very uneven, containing many small hills where the pitch has been forced up, allowing water to collect in the channels. After pitch has been removed from the lake to a depth of about a foot, the soft, viscous mass below rises to fill the hole, and again the surface hardens.

Attempts have been made to calculate the quantity of asphalt in the lake, but no definite statement can be made on the point, as there is no certainty as to the depth to which the pitch descends. Although the industry has been carried on for some years, there is but a slight alteration in the level of the lake.

The road to La Brae has been constructed on a bed of asphalt, and the latter has commenced to move very slowly away from the lake, much in the same way as a glacier slides down a mountain.

At present only the towers of the new Marconi station are completed. These are 200 ft. high and 550 ft. apart. The alternator for the wireless installation is driven by a direct-current motor which takes its supply from a battery of accumulators. The battery is charged by a dynamo driven by an oil engine. The towers, the wireless station, and the wireless plant and apparatus have been erected in Port of Spain, Trinidad, by the Director of Public Works, Mr. A. G. Bell. The contractors for the installation were Marconi's Wireless Telegraph Company. The supervision of the installation was carried out by Messrs. Preece, Cardew & Snell, consulting engineers, of Westminster.

The towers, as will be observed from the illustrations, are of tubular type, and an interesting fact in their erection is that the second of them was placed in position in the extremely short time of two hours. The peculiar construction of the towers, which were so planned that they could be put together horizontally before being raised to the vertical, alone made this feat possible. The actual hoisting of the tower into the vertical position was effected by means of two long tubular derricks and winches set on the permanent foundations.

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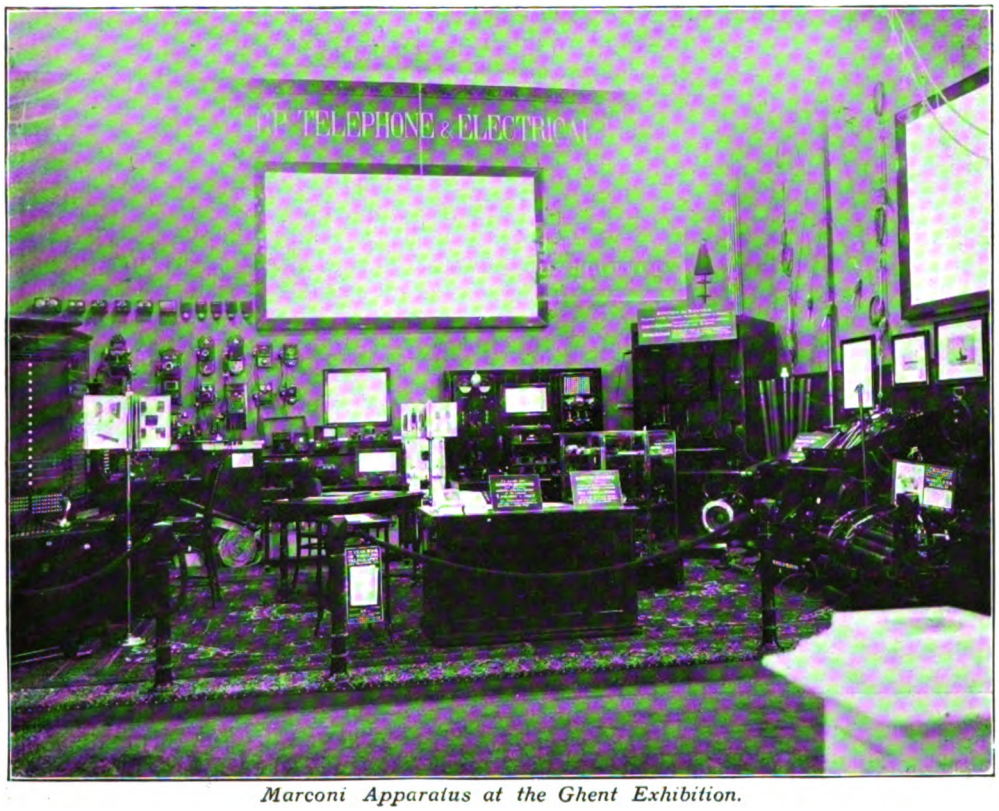
Wireless Apparatus at Ghent

VISITORS to the Ghent Exhibition cannot fail to have noticed the stand of the Antwerp Telephone and Electrical Works in the Electrical Section, known as the "Palais des Lumières," which contains an interesting display of three Marconi stations, in addition to a fine display of telephone apparatus manufactured at the famous Antwerp works.

A complete 1½-kw. station is shown, together with emergency gear. It is with this type of apparatus that the majority of liners and large passenger vessels traversing the great ocean highways are equipped, and as the installation at Ghent is fitted up just as the standard equipment is fitted on board ship, it is attracting considerable attention. The only other stations shown are a ½-kw. landing station and a knapsack station.

Among the instruments arranged on tables about the stand are various measuring instruments, including the Marconi wavemeter and decremeter. There is also a crystal receiver and a wireless direction finder—an instrument which has added appreciably to the large debt which humanity owes to wireless telegraphy by promising still further to increase the safety of life at sea.



Marconi Apparatus at the Ghent Exhibition.

Much interesting literature is available on the stand for those who desire to learn something about the apparatus which is set out for inspection, and we can recommend, as a useful souvenir of a visit, a copy of THE WIRELESS WORLD or the YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1913.

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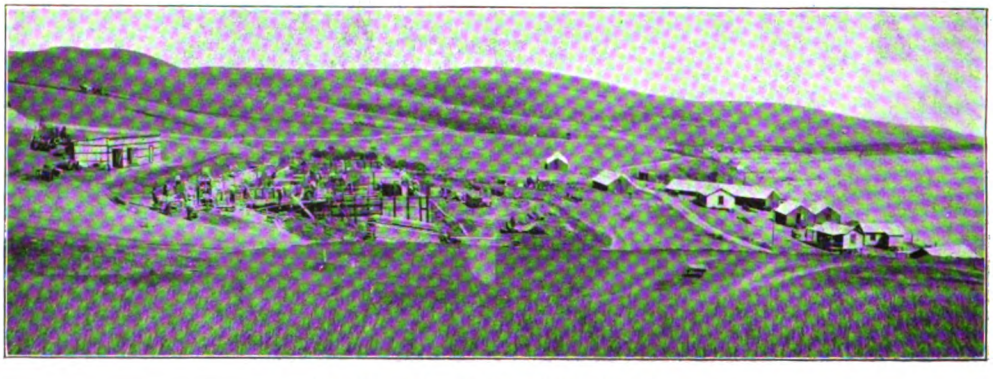
Progress of American Marconi Stations

The programme provides for long distance stations in the vicinity of New York to communicate direct with Europe and with South America. Other stations will give communication with the East from San Francisco. The programme is well on the way towards completion.

TWELVE months ago we published in the *Marconigraph* (October, 1912) particulars of an important scheme for the construction of high-power stations which the American Marconi Company had adopted. This scheme comprised stations for bringing Great Britain and the United States into more direct communication by means of wireless telegraphy, as well as stations for an American-Eastern circuit which is destined eventually to reach the Philippines and Japan. The work of erection at many of the stations is now well on the way towards completion, and before very long we should witness the fulfilment of one of the most remarkable undertakings in the history of telegraphic communication.



San Francisco Transmitting Station.

The station intended for the trans-Atlantic service will be near New York City, at Belmar, N.J. The Hawaiian station will be one of the most powerful of the group of stations which the American Marconi Company have in hand, and it will be capable of working with San Francisco and the Philippine Islands. The Hawaiian station stands on a broad stretch of land which slopes down towards the sea from the south-western base of the Koko crater (Oahu), and its location gains importance from the fact that it will serve as a relay for the transmission of messages from the Pacific coast to the Orient. The station will be duplex, that at Koko Head being used for receiving, and at Kahuku, 50 miles distant, being used for transmitting. At Koko Head five masts each 320 feet high and 1,000 feet apart in a straight line, are being erected for carrying the San Francisco aerial; 6 other masts each 450 feet high and 1,000 feet apart are being erected for carrying the Yokohama aerial. The transmitting station at Kahuku will have three steam-driven generators, each of 500 horse-power, one for working to the Pacific Coast stations, one for working with Japan, and a third for emergency use. The

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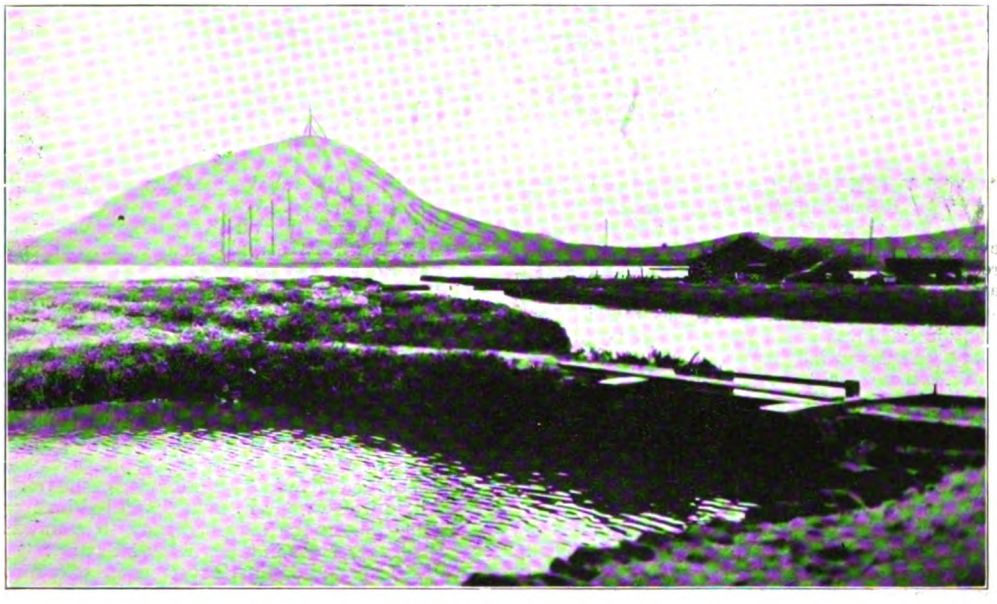
latter may be used for working either way, both to the coast and to the Orient, and will be installed in such a manner that in case of a breakdown of the power apparatus the spare set may be quickly substituted, and thus prevent any delay in the handling of the traffic.

For working to San Francisco 32 aerials each about a mile in length will be supported 300 feet above the ground by means of a double row of masts, of which there will be 12 in all. A similar arrangement of aerials of somewhat greater length supported by 14 masts, each 450 feet high, will be used for working with Japan. The completion of the Marconi station on the Hawaiian Islands will mark the beginning of a new era in wireless communication between the Islands and the outside world. While situated in the middle of the Pacific Ocean, isolated as it was from the rest of the world except for a single cable and a wireless station which works only with ships, Hawaii will be able to throw off this isolation with the coming of the Marconi system, getting into more complete touch with the rest of the world and drawn into closer relations with the country of which it is a territory.



Koko Crater, from the West Side of Kaupes Pond.

The American Marconi Company have also in hand the erection of a station at Ketchikan and another at Juneau, which will be in direct communication with Seattle. Mr. J. R. Irwin, Superintendent of the northern division of the Marconi Wireless Telegraph Company of America, left recently for the purpose of selecting the sites. The Ketchikan station will be erected at Charcoal Point about two miles from the city, and will have a 2-kilowatt plant. The early completion of this station will be of considerable importance to shippers who are interested in the North Country.

Direct wireless communication between America and Asia now is an accomplished fact, the United States army signal corps station here having opened nightly communication on July 20th with the Russian station at Anadyr, Siberia, 500 miles west of Nome.

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The Progress of Wireless Telegraphy

OUTLINED BY MR. MARCONI

At the Annual Meeting of

MARCONI'S WIRELESS TELEGRAPH CO., LTD.

"WHEN I had the pleasure of presiding at the meeting last year, I was able then to congratulate you upon the substantial development of the Company's business for the preceding year, and to inform you that I anticipated that the business of the year 1912 would show further increase, a prophecy which was fully justified and which I am sure you will agree has been substantially realised."

With these words, Mr. Marconi opened his address to the shareholders of Marconi's Wireless Telegraph Co., Ltd., at their annual meeting on August 22nd. He thought it desirable to dissipate some erroneous impressions respecting the sale of shares, and emphasised the fact that the Company did not buy and sell shares in the ordinary sense of words.

Such share transactions as were entered into were closely allied; in fact, it would be difficult to separate many of them from business which would come under the heading of contracts. To give an example: speaking in a general way, the Company might enter into an agreement to erect certain stations or do certain work, all of which, of course, was the legitimate business for which it might not be convenient at the time to pay the Company in cash. In such cases they might receive payment in shares. In due course they would dispose of a number of these shares and turn them into cash. The fact, however, was that the money which had been received for those shares was a payment for contracts executed, services rendered, or whatever the particular consideration may have been.

During the past year, as was well known, and was stated in the directors' report, the Company had benefited in this way, and accordingly they thought it prudent to take advantage of the occasion and allocate £100,000 to a General Reserve Account.

The Imperial Scheme.

Turning to the Imperial Wireless Scheme, Mr. Marconi said that when he addressed the shareholders last he little thought that they were on the eve of a campaign of a nature which he thought had never before been experienced by any private enterprise. He then added:

"I would remind you that wireless telegraphy has become an industry of considerable importance, and we are, and for many years have been, the only British company maintaining British supremacy throughout the world in this industry, and always in the keenest competition with foreign companies.

"We manufacture on a very large scale in this country, and give employment to an immense number of British workmen.

"I think that it should not be so easily forgotten that, while this Company is carrying on a remunerative business for its shareholders and establishing a large British industry, it is also accomplishing work of the highest importance for civilisation by facilitating and cheapening telegraphic communication between England, its Colonies, and foreign nations, besides greatly reducing the peril of ships at sea. Has it been our fault and have we been deserving of the treatment to which we have been submitted because we have been the only company to maintain British supremacy in this wireless industry?

"It has required the most strenuous efforts on the part of our managers and administrators to protect our interests abroad during all this period, and I am glad to say that we have succeeded in doing so. But it must not be supposed that much of the programme which we had in immediate contemplation when we addressed you last year has not suffered some delay. Our accounts speak of the progress which we have made, but that progress would have been far greater to-day had it not been for the circumstances to which I have just referred.

"When our tender for the construction of the Imperial stations was accepted in March last year, we considered, as we had every right to do, that we had entered into a definite contract requiring only such minor modifications, if any, that we might be willing to agree to in the actual wording of the agreement itself and to the formalities of ratification by Parliament. I used the word 'formalities,' for I cannot learn of any instance when a contract has been negotiated by a number of Government Departments, all of which were in continuous consultation, each putting forward proposals and suggestions and doing its utmost to obtain everything it thought it could reasonably demand and support, and finally, all being parties to the striking of a definite bargain. I cannot learn of an instance where Parliament has ever before had recourse to the sledge-hammer power which it possesses of placing a private enterprise in such a position that its only alternative to

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making further concessions demanded of it would be the imperilling of its reputation and business throughout the world.

"Such has been the anxious and responsible position which your directors have had to face, and it is therefore with no small degree of relief and satisfaction that we have been able to inform you that, notwithstanding Parliamentary intervention, we do not believe that the altered conditions of the contract will prove of any material disadvantage to the Company, but thanks only to the strong position which our Company holds.

"We have also great hopes that the Company, having emerged successfully from such a severe and ruthless attack, its reputation abroad will have been not only maintained but enhanced."

Important Brazilian Concession.

Turning to the operations of the Company in different parts of the world, Mr. Marconi said:

"Our business generally continues to make most satisfactory progress, and I have the greatest satisfaction in being able to inform you that since the issue of our report we have received a cable from our representative in Brazil informing us that a concession to which we attach the greatest importance has been signed by the President. Ever since the commencement of 1910, when our negotiations were opened, we have devoted ourselves assiduously to securing the means of opening up telegraph communication between Rio de Janeiro and other busy commercial centres of the great Brazilian Republic and Europe. There is no telegraphic service to which we attach greater importance, and you will be pleased to learn that we have obtained this concession for a period of fifty years.

"At the earliest possible moment we shall form a new Brazilian company which will purchase from us our long-distance rights together with this concession, and every effort will be made to construct the stations with the least possible delay. The new company will no doubt enter into an agreement with the American Company by which the station to be built at Para will conduct a service with New York and other parts of the United States. We hope that this work will be the start of a new network of stations opening up cheaper telegraphic communication between the South American States, Europe, the United States, and other parts of the world, which should not only secure to this Company a substantial, increasing and lasting revenue, but add considerably in value both to our interests in the American and other of our subsidiary companies. We regard the completion of these negotiations as the laying of the foundation stone of one of the most important edifices in the world of wireless telegraphy, which will further cement the business which the Company is creating independently of any competition and irrespective of any patent rights."

Progress of Subsidiary Companies.

The steady progress of the several subsidiary companies was most satisfactory, and each year was nearer to the time when, with the completion of long-distance stations either under construction or about to be constructed, the Company would realise the principal source of profit, and the one to which they attached most importance, to be derived from wireless telegraphy.

In this connection, Mr. Marconi added, shareholders would be pleased to learn that the construction of the long-distance Norwegian station had been commenced, and the consideration and wholehearted assistance which the Company were receiving from the Norwegian Government and the officials in its employ would not only enable them to complete the work within the shortest period possible, but added zeal and a pleasure to all those who were employed in carrying it out.

The report issued recently of the Marconi International Marine Communication Co., Ltd., had placed shareholders in the position of having all information in respect of the progress of that company. The works were supplying this Company with installations as quickly as they could turn them out, and it was no easy matter for them to keep pace with the demand. The continuous increase of business necessitated the issue of a further portion of the authorised capital of that company. The shares to which the Wireless Company was entitled were issued to the shareholders at the price of 5s. premium and were well applied for. The business of the company was sound and continuously increasing, and Mr. Marconi said he had every hope that the dividend for 1913 would show an increase over the 10 per cent. paid for the preceding year. He had reason to believe that the directors of that company intend in the future to pay six-monthly dividends, an interim at the end of the year, and a final upon completion of the accounts.

The Russian Company was also making most satisfactory progress, and its business had far outgrown its capital. A resolution had been passed authorising the increase of the capital, but under the terms of Russian Company Law, Government consent has first to be obtained. The necessary authority had now been given to the extent of 600,000 roubles, and further authority was asked for a like sum. The shares of the Company being 100 roubles, the directors had in contemplation arrangements under which the shares would be available for conversion into £1 shares in a Trust Company in order to have a market value for them in this country.

A new subsidiary company had been formed in Australia. During the year a very large business had been done with the Italian Government, and the Company continued to enjoy their full support and confidence.

Other important negotiations were pending.

A new company was about to be registered under the style of "The Betulander Automatic Telephone Company, Limited," which would purchase from the Marconi Company the patent rights and take over the contracts and negotiations which had already been entered into in numerous countries respecting automatic telephones.

The magazine entitled the *Marconigraph*, with which most shareholders were familiar, having developed into a really important publication, its title had been changed to that of THE WIRELESS WORLD, and it had a circulation of about 20,000 copies per month.

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The Publicity Department had also produced during this year the first YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, a publication which had met with considerable success and would be an annual production.

Electric Waves.

Although, said Mr. Marconi, there was no doubt that Wireless Telegraphy was in a condition of rapid development, he thought that it could safely be said that this method of communication was based, and would continue to be based, on the production and utilisation of electric waves.

Continuing, he said:

"There seems to be a prevalent misconception in the lay mind that continuous waves are in some way essentially different from the discontinuous waves produced by what are called spark systems. Such a view is quite erroneous. The Marconi Company possesses methods of its own which permit it to utilise where and when it thinks desirable either a spark system or a continuous wave system, and this was demonstrated to the members of the Advisory Committee appointed by the Government during the tests carried out for them between Clifden and Glace Bay.

"My system of continuous waves is now installed and in working order at the Transatlantic Station at Clifden.

"Important tests are now being conducted, but considerable work and time are required before it will be possible to determine in a definite manner whether the continuous wave system possesses advantages for long-distance transmission over the discontinuous, or which is called the spark system.

"In any event, I think it well to make it quite clear that the Company possesses efficient method for utilising either system.

"As in the past, we have this year applied for several, and what I believe to be valuable, patents which embrace further important improvements in the transmitting and receiving apparatus.

"I should like, without in any way desiring to belittle the attempts made by others to establish communication by means of wireless telegraphy across the Atlantic, to point out to shareholders that the achievement of telegraphing across the Atlantic is not such an easy matter as it may appear, and I think that the public and even distinguished inventors have erred on the side of optimism with regard to what they expected would shortly be done.

Unfulfilled Promises.

"During the last few months we have read in the public Press that communication was shortly to be established between Europe and America by means of the Poulsen or Goldschmidt system. I should like to remind you that Prof. Fessenden, writing in the *Electrician* issue of February 22nd, 1907, said that in January, 1906—that is well over seven years from this date—he received messages in Scotland from Massachusetts with an expenditure of less than 1 kilowatt of electrical energy. Again, Dr. Poulsen, in the *Electrician* of November 15th, 1907, nearly six years ago, said: 'The engineers of the company are very confident that they will succeed in printing transatlantic messages, and are positive that they will not be limited to telephonic reception.' Then again, with regard to the De Forest system, we have the following extract from the *Electrical Review* of April 6th, 1906—seven years ago: 'The daily Press announces that the De Forest Wireless Telegraph Company has sent messages from its station at Coney Island to Ireland, a distance of 3,200 miles. On one night 1,000 words were transmitted, of which 572 were received and recorded.' It is further added that 'when the correct pitch to use for Ireland has been ascertained, commercial work will be started across the Atlantic. It is then proposed to send messages from San Francisco to Ireland, with two relay stations.' None of these systems I have just mentioned has yet succeeded in establishing a service of any kind across the Atlantic, notwithstanding these statements which were made six or seven years ago."

The Dividend.

Mr. Marconi said there was no doubt some little disappointment at the Company not declaring a second interim dividend in December last, and also that they should have decided to recommend a final dividend for last year of 10 per cent. on both classes of shares, which represented 17 per cent. for the Preference and 20 per cent. upon the Ordinary. The unforeseen circumstances, however, which occurred since his last address had dictated a policy of prudence with which he felt sure shareholders would not quarrel.

In such a new industry developments were continuous and led frequently to sudden and substantial demands upon resources, and they had thought it wise, therefore, not only to carry to Reserve the sum of £100,000, but also to carry forward to next Account £146,000.

He hoped that circumstances such as had prevailed this year would not recur, and they should therefore be able in the future to hold their General Meeting a month or two earlier than they had been able to do on the present occasion.

At the end of each year they should be in a position to estimate approximately the profit earned during the year, and so decide upon any interim dividend which should be declared and paid at that period. By adopting this course, assuming their business continued to progress as they hope, distributions would take place six-monthly. Concluding, Mr. Marconi said:

"Your managing director, Mr. Godfrey Isaacs, has been subjected to a great number of most ungenerous insinuations—(hear, hear)—which never could have been made by anyone personally acquainted with him, and which could not be and are not believed by anyone who knows him or who has worked with him. (Hear, hear.)

"But it would appear in this country, as in most others, when politics are introduced an atmosphere prevails in which there would seem to be let loose some pernicious element destructive of the equilibrium of an otherwise well-balanced mind. (Laughter and applause.)

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"I think Mr. Isaacs merits the most sincere congratulations of the shareholders on having carried on the business so successfully during the past year under the great difficulties which I have referred to, and considering what a great amount of time was taken up in defending the interests of the Company and even in protecting his own honour and reputation, all of which he has done so effectively. (Hear, hear.)

"Mr. Samuel, H.M. Postmaster-General, speaking in the House of Commons, stated: 'I could wish no worse fate for any of my critics than that in the next world they should be condemned to conduct in perpetuity negotiations of this character under these circumstances.' (Laughter.) I can truthfully state that I am sure that Mr. Isaacs on his part could express identical feelings.

"I now wish to move: 'That the Report of the Directors, submitted together with the annexed statement of Accounts at December 31st, 1912, duly audited, be received, approved and adopted.'"

The Past Year.

Mr. Godfrey C. Isaacs (Managing Director), who on rising to second the resolution was received with applause, said:

"It would be idle for me for a moment to pretend to you that the troubles which we have gone through during the past year have not been of an extremely painful nature to me. (Hear, hear.) You are perfectly well aware that all manner of suggestions and insinuations of the most sinister nature have been levelled at me, and it has required all the assistance, the support, the confidence, the loyalty, and the encouragement which I have received, firstly from our illustrious chairman, secondly from every single member of my Board, thirdly from every manager and head of department throughout the whole of this great Marconi organisation, and fourthly, and to which I attach no small degree of satisfaction, the immense number of letters which I have received from shareholders not only throughout this country, but I think I may say throughout the whole world, in which they have expressed their deep sympathy and their absolute confidence. Under those circumstances, and largely due to those circumstances, one has been able to face a condition of things which became well-nigh otherwise intolerable. But, ladies and gentlemen, we have had during this past year a trouble far more serious, and which occasioned me and many of us much greater anxiety than that to which I have just alluded. I refer to the most unfortunate accident which befel our Chairman. I am quite sure that everybody who has known him, or who has heard of him—and in saying that I think I might say almost every living soul throughout the world—sympathised with him and were as anxious as we were to hear of his progress. It is with a very considerable degree of satisfaction that we are thankful to-day that our Chairman has returned to us I might say certainly not the worse for his accident, and in so far as I am able to gauge, and as far as I thoroughly believe, with even greater inspiration than was his before."

Wireless Telephony.

During the last six or eight months, said Mr. Isaacs, he (Mr. Marconi) had taken out a very large number of very important patents—patents which he felt sure were going to play a part at least as important, if perhaps even not more important, than the patents which he had taken out in the past. They would no doubt see further important developments in the industry in which they were engaged, and in which they looked to him to continue to pioneer, and he was quite confident that so long as Mr. Marconi was with them, they, the Marconi Company, would continue to pioneer that great science of which he was the inventor.

Mr. Isaacs added:

"We all know that through Mr. Marconi's genius when we go to sea we are able to receive telegrams with our morning cup of tea from those whom we have left behind. I am not very fond of prophesying, but I am going to venture on this occasion to prophesy that the date is not far distant when with our cup of tea in the morning we may hear the ring of the bell, and, taking our telephone from its hook, we may talk to those whom we have left behind; we may tell what sort of night we have passed, and learn what sort of a night they have passed, and be able to speak of the disposition we may feel towards our coming breakfast. (Laughter.) The Marconi Company has not made it a habit—and I think in that they have perhaps been influenced by the modesty which we have all learned so much to love of our Chairman—to boast at any time of the work it was doing or contemplated doing. I suppose you have all read, as I have frequently read, paragraphs in the papers speaking of the wonderful things which were being done by those whose names perhaps most of you do not know in connection with wireless telephony. Well, all I want to tell you is that whatever you have read in the papers as having been done by wireless telephony, the Marconi Company has done more. But until the Marconi Company is prepared to say exactly what definite results in a practical way can be obtained from wireless telephony it will remain silent. We shall perhaps at an early date be able to turn wireless telephony to practical commercial account, and it will then be time enough to speak."

Some of our shareholders, he said, had perhaps been a little disappointed in connection with the progress, which was slower than they would hav liked, of one or two associated companies, but he would ask them to remember that in an industry of this nature a little time was required in any country for the development of that industry and turn it to profitable commercial account. There were innumerable difficulties to be surmounted, particularly when it was remembered that for the most part one had to negotiate with governments abroad. Mr. Isaacs expressed the thanks of the Company to the managers and heads of departments, and the whole of the staff, and to their different representatives and agents abroad, who had given during the past year the greatest possible assistance in very trying times. The pension scheme was on the eve of completion, and the company were providing a sufficiently substantial sum

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towards that pension scheme to warrant the directors not asking the shareholders to authorise something in addition in the shape of a bonus.

The Future of the Company.

In conclusion, Mr. Isaacs said :

"I do not think there remains anything further for me to say to you at this moment other than, perhaps, to repeat what our Chairman has told you, namely, that our business continues to progress in a very satisfactory way, and that our principal attention is directed to the creation of what we believe will be the most profitable side of wireless telegraphy in the shape of constructing and conducting long-distance telegraph services throughout the world. I think that every month we are coming nearer to realising that end. In the course of a little time, when many of the stations which are now under construction, and in a little time more when many of the stations which are about to be constructed are completed, you will realise that we have created a sound, substantial and profitable business which will be entirely independent of whether or not others are able to introduce something which Mr. Marconi has not previously thought of in connection with wireless telegraphy. It now only remains for me to second the resolution submitted by the Chairman."

Few questions were asked, after which the resolution was put to the meeting and carried unanimously.

The Chairman : I now move : "That a final dividend for the year ending December 31st, 1912, of 10 per centum on the 250,000 Cumulative Participating Preference shares be paid on October 1st, 1913, to the members who are on the register as present holders thereof." Also, "That a final dividend for the year ending December 31st, 1912, of 10 per centum on the Ordinary shares be paid on October 1st, 1913, to the members who are on the register as present holders thereof."

Capt. H. Riall Sankey : I beg to second both resolutions.

The resolutions were carried unanimously.

Mr. Isaacs : I have pleasure in moving : "That the retiring Directors, Commendatore Guglielmo Marconi, Mr. Alfonso Marconi, and Capt. H. Riall Sankey be re-elected Directors of the Company.

Mr. H. S. Saunders seconded the resolution, which was carried unanimously.

The Chairman : I have now to declare formally : "That an interim dividend in respect of the year 1913, of 7 per centum on the 250,000 Cumulative Participating Preference shares, will be paid on October 1st, 1913 to the members who are on the register as present holders thereof."

Mr. Mooney : Mr. Chairman, will you permit me to perform what is a very pleasant duty ? I have never been at a meeting where there was less dissension amongst the shareholders as to the management of the business, and I beg to propose that the thanks of the shareholders of the Company are due and are hereby given to the Board of Directors for their extremely capable management of the affairs of the Company. I think that I am particularly qualified to propose that. For many years I have been the friend of Mr. Marconi—I hope he will allow me to call him such—being almost one of the first to join the Company, and I have seen Mr. Marconi working in it for fully sixteen years. During that time he has worked in season and out of season, day and night, in the interests of the Company, for the completion, so far as it has been completed, of the success of the Company up to the present time. No man could have given more work or more knowledge, for not only is Mr. Marconi a great scientist, but, when it came to a question of managing the business for an interim he took upon himself the position of Managing Director, and proved himself a very fine business man. I have not known Mr. Isaacs quite so long as the Chairman, but we can all judge from the present position of the Company what work he has done in conjunction with Mr. Marconi. I should like to say a great deal if time permitted about the other members of the Board, some of whom sat on it with me in years past. At any rate, I can tell you that they have had to work harder in the years past than they have to now, I am pleased to say, the Company being now in quieter waters so far as the question of being overtaken by a competitor is concerned. Then I should like to say a lot about our worthy Secretary, whom I have known for many years. I should also like to speak about the various members of the staff, who I know are loyal, earnest, hard-working, and capable. I have the greatest possible pleasure in proposing this resolution.

This was carried unanimously, and a brief response by the Chairman terminated the proceedings.

Wireless Telegraphy in Argentina.

Some interesting particulars of the progress in connection with the establishment of a high-power station in Argentina are given in the report of the directors of the Compania Marconi de Telegrafia sin Hilos del Rio de la Plata (Argentine Marconi Company) for the year ending May 31st, 1913, which was presented at the annual meeting of the Company held on August 29th. The station is intended to maintain direct communication with a similar station to be constructed in England, a distance of about 6,000 miles. Direct communication will be maintained with Europe at all hours of the day and night without interruption. Sites have been acquired in the vicinity of Punta Piedras, where both the transmitting and receiving stations will be erected. Arrangements have been made with the Buenos Aires and Great Southern Railway for the construction of a branch line which is to connect the main line with the station. During the past financial year the directors, in conformity with Article 13 of the Statutes, appointed Mr. Florence O'Driscoll, Mr. Carlos Pereira Pinto and Dr. Julio Puyrredon to fill vacancies on the board of directors.

Share Market.

LONDON, *September 22nd*, 1913.

The market in the various Marconi issues has been fairly active during the past month, and a very considerable investment business has been done.

The present prices show little change since we last went to press—Ordinary $4\frac{1}{8}$, Preference $3\frac{7}{16}$, Canadian 12/-, Spanish $\frac{9}{10}$, American $1\frac{1}{8}$.

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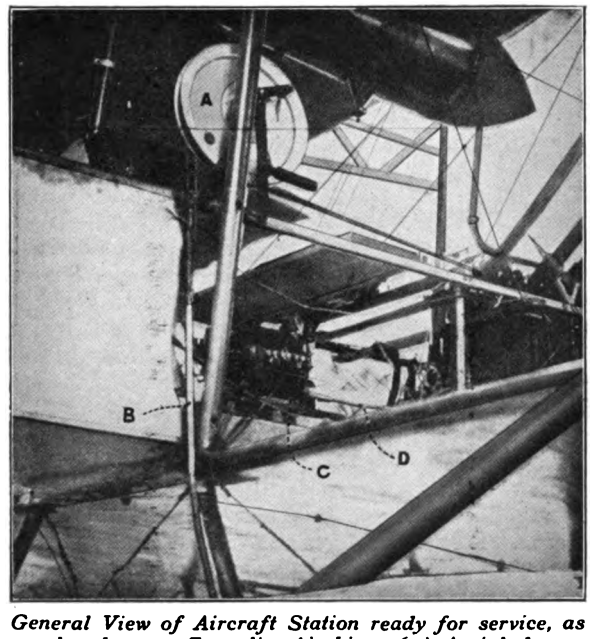
Wireless and Aircraft

THE one gleam of hope arising from the sad airship tragedy in the North Sea, which occurred on the night of September 9th, is the demonstration that wireless telegraphy is destined to become an important factor of safety in connection with aircraft. The victim of that tragedy was the German naval airship LI., which was destroyed with a loss of 14 men, eighteen miles to the north of Heligoland. The vessel, which was in charge of Captain Hanne, was caught in a storm of considerable violence that set in without warning, and she was hurled to the surface of the sea and wrecked; she sank an hour later.

In the gangways of this airship was built a room for wireless telegraphy, and, according to accounts appearing in the Press, the airship was in wireless communication with Heligoland and with the torpedo-boat flotilla. Further, it seems certain that when the storm grew threatening, Captain Hanne sent out messages for assistance. Unfortunately this assistance arrived too late to rescue all the officers and members of the crew of the ill-fated vessel, but that the wireless service enabled the airship to get into touch with land and with other vessels is a sufficiently convincing proof of its usefulness.

A good deal of work has been done in the direction of applying wireless telegraphy to aircraft, which has demonstrated in so unmistakable a manner its potentialities as a life-saving medium. But wireless has already been found useful on airships for checking chronometers and finding the position of the ship by the three-point problem of surveying.

The applications of this remarkable agency are now so widespread that much progress has been made in directions which in the ordinary way receive but little recognition, and its application to aircraft one of them. The advantage of being able to communicate with land or other stations whilst in the air has been exemplified on many occasions, notably in the case of the now almost forgotten Wellman flight, when an unsuccessful attempt was made to cross the Atlantic some years ago. The tragedy of the North Sea is another instance of what wireless telegraphy is capable of, although it must be remembered that it has other useful functions to perform which are essential to the safety and proper navigation of aircraft. This point was emphasised by Col. J. D. Fullerton in a paper which he read before the Royal United Service institution, dealing with aeronautical progress, and in which he referred to the usefulness of wireless telegraphy on board airships for checking chronometers and finding the position of the ship by the three-point problem of surveying.



General View of Aircraft Station ready for service, as employed on a Zeppelin Airship. (a) Aerial drum; (b) Insulating tube for Antenna; (c) Alternating current generator; (d) Flexible shaft.

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NOTES OF THE MONTH

WIRELESS TELEGRAPHY IN THE TROPICS. THE ADEN-BERBERA SERVICE. WIRELESS SCHEME TO LINK FRANCE WITH THE FRENCH COLONIES. THE METEOROLOGICAL OFFICE REPORT. IMPERIAL UNITY. WIRELESS AND EXPLORATION.

IF the full details of the recent events in Somaliland were known, they would probably indicate that wireless telegraphy had been of some assistance, if only in the direction of allaying the fears of the people of Berbera by summoning reinforcements from Aden. Two medium-power stations have been completed at these points, and these formed the subject of an article in the April number of THE WIRELESS WORLD. The annual report of the Somaliland Protectorate, which was issued during the past month, gives some further particulars of the Aden-Berbera wireless service, which was satisfactorily maintained throughout the year without breakdown. According to the report, the apparatus and machinery are standing the strain of the tropical temperature and atmosphere remarkably well, depreciation being at a very low rate. Mr. Archer, the Acting Commissioner, points out, however, that electrical plant and instruments are subjected to very considerable strain, owing to the general high temperature and the quantity of fine sand which penetrates and collects almost everywhere during the Kharif season. It has, therefore, been decided to duplicate, at both Berbera and Aden, all apparatus in which the liability to serious breakdown exists.

* * *

In May the Berbera radio-apparatus and machinery were transferred to a new stone building erected as a radio-station. Great advantages have been derived from the transfer, which was effected without any prolonged interruption in the service. Arrangements have been made to install rotary disc high-frequency dischargers capable of producing a musical signal of a note equivalent to 600 vibrations per second. This is expected to overcome very considerably the difficulty experienced when communicating during the times when atmospheric or static electric charge effects prevail.

At the Aden station a twenty-four hours' service is maintained, while at Berbera, in addition to the day service, the station opens at 8 p.m., to establish communication with any ship within night range.

* * *

All ships fitted with wireless apparatus and passing to and from Europe and the East establish communication with both Aden and Berbera, and maintain "touch" for varying periods from twenty-four hours upwards. The number of communications established with each station during the year 1912–1913 was 897. During the year under review there has been a slight falling off in the number of messages received, namely, 3,215, as against 3,287 of the previous year. The service is considerably used by warships, captains of liners, and shipping agents, besides the travelling public. Arrangements have been made to install a small wireless station at Bulhar to replace the land line to Berbera, which has been a continual source of trouble throughout the year, and has proved unsuitable. The station when completed should have no difficulty in communicating with the wireless station at Berbera under the worst atmospheric conditions. It is expected that a considerable saving in upkeep and a more efficient service will be the result of the change. It is not intended that the Bulhar wireless station should communicate with ships, and therefore a short and a little used wave-length has been selected. However, the station will, during working hours, be prepared to receive distress signals and to communicate with any ship requiring assistance.

* * *

The Budget Commission of the Chamber of Deputies have framed a Bill proposing the establishment of a wireless telegraphy system between France and the French Colonies at an estimated cost of £631,800. The Bill provides for the erection of a station in the South of

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France which will communicate with chains of stations extending to the Far East, Africa, and South America, and to the Pacific. The stations in the Eastern chain comprise: Tunis, Djibouti, Pondichéry, Saigon, and Madagascar. In the African and South American chains it is proposed to erect stations in: Morocco, St. Louis, Tombouctou, and Bangui. The Pacific chain will comprise the following stations: Morocco, St. Louis, Martinique, Tahiti, Marquises, Nauméa, and Saigon. A station will also be erected in the East of France to communicate with North America.

* * *

The annual report of the Meteorological Committee published during the past month contains much that is interesting, but that which will, in all probability, attract the greatest attention is the reference to the part played by wireless telegraphy in modern weather forecasting. It is pointed out that during the twelve months ending with March, 1913, 5,385 wireless reports were received from Atlantic liners. The numbers in the several months ranged from 500 in September to 377 in February. The number of messages is greater by nearly 450 than the corresponding figure for the twelve months ending with March, 1912. During the year, 81 wireless telegrams were received from the ships of His Majesty's Navy. The arrangements for the receipt of wireless messages from H.M. ships have been revised. In order to avoid the unnecessary dispatch of reports by ships in close proximity to the telegraphic reporting stations on the coast, arrangements have been made to restrict the reports to ships south of latitude 48°. These reports are often of great value, as they are generally received from the Bay of Biscay, and the office does not receive reports from ships of the mercantile marine crossing the Bay. The value of these was distinctly proved by their effect upon the forecasts, for most satisfactory results have been achieved. There can be no doubt that weather forecasts are now more accurate than was formerly the case, and the figures given above should enable the public to realise that wireless telegraphy is an important factor in the improvement.

* * *

When so much has been done by modern science to make straight the path of Imperial unity and progress it appears almost impossible to conceive of a closer relationship due to increased facilities of intercourse. Yet even in this branch of Imperial service, where the maximum of achievement seems so nearly attained, another record has been made in inter-colonial communication. Of course it was effected by means of wireless, and the feat was something for those who accomplished it to be proud of, for they maintained communication over a distance of more than 10,000 miles during the week ending September 13th. By the medium of the flagship *Australia*, travelling from Durban to Albany, a message from the Governor of New Zealand to Lord Gladstone at Pretoria, through Cape Town, was sent from Wellington to the high-power station at Sydney, thence to Perth, thence *viâ* the *Australia*, in mid-ocean, to Durban. Lord Denman also sent a message asking that his greetings should be conveyed to Lord Gladstone, adding that he was glad to learn that South Africa and Australia were in touch by means of the flagship of the Commonwealth.

* * *

Wireless telegraphy is now recognised as a *sine qua non* of all exploratory expeditions. This is the only possible channel of communication which can link them with the outside world, and what this means, both to the explorers themselves and to those who are waiting anxiously, it may be, for news of them, only those who have experienced the desolation of exploration can describe. But the despatches received by the Press from the Mawson Expedition at Adelie Land, in the Antarctic, give some idea of the important part it plays in modern expeditions. Now another instance of its efficacy is to hand, for a wireless message has just been received at Sydney, by Mr. Glynn, the Commonwealth Minister for External Affairs, from Judge Murray, the Lieutenant-Governor of Papua, that the Massey Baker expedition has safely returned to civilisation.

Mr. Massey Baker is the resident magistrate of the western division of Papua, and some months ago he left Daru in order to explore a tract of country hitherto entirely unknown to white men, and among other interesting discoveries, a vast lake, over 100 miles in circumference, was located. Beside this lake a large number of bodies were found, and it is supposed that they were the victims of a tribal fight.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire. His most recent invention is an airship worked by wireless, which is likely to revolutionise aerial warfare. Negotiations are proceeding with the War Office for its purchase from the inventor.*

GWEN THRALE.—*Charles Summers' fiancée, a bright, intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society. She coaxes Summers to teach her "wireless," and soon becomes a proficient operator and a bit of an engineer.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip. They are discovered and "tapped" by——*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly they belong to the leisured and wealthy class; but in reality they are secret agents for a foreign Government sent over to England for the purpose of securing military or naval secrets. Their attention is directed to Summers' work, and they determine to get possession of the airship's plans.*

CHAPTER VI. (*contd*).

"MAISTER SUMMERS lookt mortal grave an' say sutthin' to 'im low like, an' jest then the train cum in an' I couldna' hear na more, but as it wer leavin' the station one of them leaned out of the window and cried out, 'By Thursday, then,' an' Maister Summers he shouted back, 'Yes, the 10th. I'll post it Wednesday, and you'll get it Wednesday evenin' or Thursday mornen at latest, for I won't leave the office until I've cleared it off, and what's more, I'll post it myself.' There, now, zur, I beant old Suk if that ain't news, for I believe Maister Summers be going to sell that thing for a pot of money, and then these aristocrats will send their devil cars to frighten us puir folk who can't defend themselves."

Dupont was deeply interested in this recital. He drew in his breath with short gasps, which sometimes became low whistles. This was a good sovereign's worth of news, but he didn't quite know how to make the best of it.

Anyway he must act at once if he was to act at all, and there would be no harm in following out his first plan; so he approached Suk for help in the scheme. What he asked her to do was something extremely simple. She was to call at the Vicarage at half-past eleven next morning, *exact to time*, and ask to see Miss Summers. "Understand," he added, "you must find some excuse. You must say something that is—here, Beulner, what do I want to say?—*Raisonable*—yes, you must say something raisonable, you understand me, and you must not fail, for if you do you will lose more gold, and besides, I shall be able to do you great harm. You understand?"

Yes, Suk understood. She inwardly cursed the coercive tone of Dupont's last remark, but she knew which side her bread was buttered, and she was not the one to throw up such chances of earning unexpected wealth for the want of controlling her temper; so she nodded and bit her lip.

Dupont made her repeat the arrangements, so that everything might be clear, and once he was satisfied she knew the part she had to play in the manœuvres, he went back again to Beulner. Then he explained his scheme to him, and it was received with approval.

Beulner learned his part in the game to a nicety. Early on Monday morning Beulner

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set out for what was apparently a day's solitary rambling. About eight o'clock he was to be seen in a Norfolk suit with a camera slung in a satchel over his shoulder, and a packet of what was apparently sandwiches under his arm, making his way through Sotheby towards the Downs. As chance would have it, he met Summers on his way going to business. They exchanged greetings, and Beulner took the opportunity of remarking that he was going for a day's botanising and general lazying about, pointing to his sandwiches as corroboration of his intentions. Summers, making some pleasant remark, passed on, and Beulner proceeded up the hill, past Sotheby Vicarage. He came to the open Downs, then turning down a side road which ran parallel with Sotheby highway, he took up a position on a bank which overlooked the only road leading from Thrale Hall to the Vicarage. There he got out a book, threw himself on a grassy bank, and generally lazed away the time. But he did little reading. In reality he was very much on the alert, keeping a constant eye on the road, and carefully scrutinising what passed up and down. This was not a difficult task, for only one or two solitary pedestrians made their way across it, and a tradesman's cart or two passed in behind the gates. Meanwhile Dupont was waiting in the "Granby," till the clock hands showed ten minutes to eleven. Then he made his way to Sotheby Vicarage. After ringing the bell, he asked the maid if he could see Miss Summers, and waited in the hall till that lady appeared. Then he explained the reason of his call. He had lost a pearl pin—a very precious heirloom, which, if not recovered, would be a great grief to him, not only from the intrinsic value of the thing, but for sentimental reasons. He asked to be allowed to look around the garden and in the drawing-room to see if he could find it. Of course Miss Summers raised no objection. Further, she helped him in his search, but all efforts proved unavailing. The carpet was swept, the chairs were overhauled, the flower beds and round the gravel paths carefully scrutinised, but all to no purpose; and, as the fruitless search proceeded, Dupont became gloomier and gloomier, till he looked like a man who had staked his all and had lost. Miss Summers could see that he was bitterly disappointed, and she—kindly soul—was most anxious that he should find the pearl. Was he sure that he had lost it after he arrived? Oh, yes, Dupont could swear to that, for his friend had remarked about it just before they entered the Vicarage drive, and he himself had discovered his loss when he got to the "Granby." He had not called on the Sunday because he knew they would like the time to themselves, for to the English people Sunday was sacred, it must not be touched, and visitors were *ennuyeux*. Miss Summers thoroughly approved his kind thought—now was there anywhere else he had been that afternoon? Yes, there was Charles's den, but unfortunately it was locked, and Charles, she knew, had the key. Dupont was then in despair. He had to go back to town that evening. For several days he would be away, and he had so hoped to get possession of his treasure. By the way, he remembered he had a number of keys with him, and, what was more to the point, a *passe-partout*. Would she give him permission to try it? Yes, Miss Summers had no objection. She was sure Charles wouldn't mind under the circumstances, and so the lock was tried and successfully negotiated. She and Dupont entered, and recommenced the search. The Frenchman was now very flurried. He kept looking at his watch, saying he could not stay very much longer, as he must keep this important appointment in town. If only he could find his pearl, if only he could! Miss Summers was searching diligently. Could it have fallen on the floor? Was it likely to be on the table, or near the airship? It was such a little thing, and so difficult to find; in fact, it was like searching for a needle in a bundle of hay.

At this moment the servant came in. She had been searching for Miss Summers everywhere. Suk the Pedlar had called, and wanted to see the lady. Mrs. Linn's grandchild had cut itself sore, and was bleeding to death. They could not get a doctor, and could Miss Summers give her some medicine and a bandage? Yes, of course Miss Summers could. She was looked upon as the first-aid woman of the district, a kind of vice-doctor and district nurse, and amateur chemist for all the poor people. This was not an uncommon request,

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but like most requests of its kind it had to be attended to quickly. With a word of excuse to Dupont, she hurried out to her medicine chest. Now was the Frenchman's time. Quickly he went to the long table and seized some unused paper and envelopes. These he shoved into a big book with which he had come provided. There was still time to spare. Could he get at the correspondence? He knew it couldn't be very far away, and viciously he pulled at the table drawer. It was unlocked, and he soon found two neat piles of papers, the one containing letters received, and the other copies of letters sent away. He turned his attention to the latter bundle, and hurriedly skimmed the earlier documents. Dupont might not be very fluent in his English speech, but he knew the language vastly better than most Frenchmen, and it only took him a few seconds to read through the few letters before he came to the one he wanted. It referred to a visit from Major Thorpe on Friday, June the 25th, and corroborated his promise to write an official specification of his airship, and send it to the War Office by the following Thursday. In it the writer asked for these few days' grace as he was anxious to get some expert advice on technical matters, but he hoped to see the consulting engineer on the following Wednesday, and if everything was satisfactory he would post the plans himself *in London* that same evening, so that there should be no possibility of undue delay. But a letter a little lower in the file was the one which Dupont had most hoped to find. It was to the engineer in Victoria Street, making the appointment for the Wednesday. The Frenchman heaved a sigh of relief. He had got what he wanted, but the strain of the enterprise had been great, and its success had been in the balance. Still, he was not out of the wood yet. He must now make his escape. Quickly pushing back the drawer, he resumed his fruitless search, and appeared to be intently studying every corner of the floor when Miss Summers appeared again.

"Oh, Miss Summers," he cried, "it is all to no purpose. I cannot find the pearl. I am in despair; nevertheless, I hope still, for surely it must be here somewhere. Perhaps you will remember me and my loss, so that if you find it at some time you will let me know. I will give you my address, or, if you care, there is Mrs. Bundross at the 'Granby Hotel,' whom I will tell, and who will tell me, I hope, the news of its refinding when next I come again. It will not be, I fear, for many days, but I do know that however long I be, the jewel will be in most safe hands."

Certainly there was nothing more to be done, and Miss Summers could only once again deplore the fruitlessness of the search. When she had at last seen the unlucky stranger out, she continued her interrupted morning's work.

Dupont was soon back at the "Granby Hotel." Then he took the grey car, and went round the high road to where he knew Beulner would be waiting for him. The outpost had been unnecessary. Miss Thrale had not yet made her appearance, and nobody of consequence had passed; so the would-be botanist joined his companion in the car, and soon the grey machine was making its way to London.

When Charles came home in the evening, he was told Miss Summers's version of the day's event. At first he listened quietly, but as his sister proceeded his face grew sterner and sterner. He clenched his hands, and Miss Summers had never seen him so angry. He lost control of himself: a thing he had never before been known to do. He declared that those men were damned scoundrels, and that they were no good; and as for the pearl, he was sure it was all a damned lie. He didn't know what they were up to, but he believed they wanted to find out about his work. What the deuce did she let the snivelling Frenchman in for? What was the good of his putting a strong lock on the door if any fool of a foreigner was to open it with a skeleton key? The thing that made him most suspicious was the fact that that infernal old scoundrel Suk had turned up again. He had chivvied her off before, and told her to go about her business, and here she was back again just at the most inconvenient moment; and as for widow Linns, he would go round and find out whether she had a grandson, and whether anything was the matter with him. He bounced off white with rage, taking great strides down the path, and slammed the gate after him as he made his way to the end of the village.

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In a short time he returned and faced his sister. He had seen the Widow Linn's grandson fast asleep in bed and sound in wind and limb. The two looked at each other hard, but made no word of comment. They both realised that they had been the victims of a cunningly laid plot.

CHAPTER VII.

THEY PLAY TO WIN.

The next few days passed like a nightmare to Summers. He was sure that a trick had been played upon him, but its exact nature was a mystery to him. A rigorous search of things in his lab. failed to give any clue. Apparently everything was in its right place and not even a sheet of paper appeared to have been disturbed by the intruder. A second visit to Mrs. Linn and a judicious inquiry as to how the report had circulated regarding her grandson's accident failed equally in results. Furthermore, Doss and Suk had been careful to leave no trace of their whereabouts, and as far as Sotheby was concerned, they had vanished into thin air. Charles, therefore, had to content himself with leaving the matter in this unsatisfactory state, but fortunately for his peace of mind his time was too occupied to allow him to dwell on the mystery. His specifications for the Government needed considerable revision before they could be sent off. This occupied all his time till the Tuesday afternoon before the day appointed when he was to consult the engineer. It had been arranged that after his visit to London he should take a much-needed holiday in the North, and it was likely that if the weather continued fine he would be away for a week or so; he had therefore arranged to spend the evening at Thrale Hall. Ostensibly it was to say goodbye, but his mind was more concerned with the perplexities of the moment than with the mere fulfilment of courtesies. He dared not leave the neighbourhood without first telling Gwen to be on her guard, and hitherto, since the affair of Dupont, it had been impossible for him to see her alone even for a few moments. Of course she knew about the excitement in a general way, for Miss Summers had speedily poured her own garbled tale of mystery into her friend's sympathetic ear. Summers, however, wanted her to have his own version of the matter. So it happened that when the anticipated "quiet talk" took place, it was not spent in the manner fondly imagined by the outsiders who, as onlookers, flattered themselves that they saw "most of the game." Instead, practically the whole time was given up to very businesslike talk, and the comparing of notes between two very serious wireless collaborators. It failed, however, to throw any fresh light on the subject or deduce any definite motive for the trick. Certainly the general purpose of Dupont's action was clear enough. He had some particular reason for finding out more about the airship. But if so, why did he leave untouched important papers which he might have confiscated without any fear of discovery? Could they only answer that question the way would be easier, and their course of action clear. But it was exactly at this point that they were baffled. It did not strike them that Dupont wanted the specifications to be approved by the consulting engineer before he appropriated them to his own uses. In the end they agreed that the only thing to do was to keep quiet about the whole affair, and Gwen promised neither to refer to the subject again before Miss Summers, nor, if she should meet the two foreigners while Charles was away, to show them by the slightest difference of manner that their secret motives were even suspected.

Time proved these precautions to be quite unnecessary, the grey motor-car came nowhere near Sotheby. Its owners were busy in London, very busy indeed, making elaborate preparations for the Wednesday when Summers was to send off his draft to the War Office.

Early on the day appointed by Charles for his interview with the engineer, a dark foreigner with an enormous black beard, a ragged Inverness coat, and a slouch hat, was seen strolling up Victoria Street. In his hand he carried a stout ash stick, which he from time to time tapped on the kerb in negligent fashion, as though he were sauntering along this high road without any particular aim, but merely as a poor Continental cousin come over to see the great city, and to receive impressions. He sauntered round St. Anne's Church, tried the doors, and found them locked, so sauntered on again and entered Caxton Hall. Apparently the exhibition there failed to interest him, and he soon came

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out again. Then he bought a paper, made his way to a friendly restaurant and took a prolonged lunch—an elaborate *petit déjeuner* of coffee, rolls and butter. Meanwhile he read scraps of news or looked out of the window on the crowd below. At last he saw something that interested him, for he folded up his paper, and without finishing the already buttered slice of roll, asked for his bill and went out. This time he walked faster, with a springy and alert step, picking his way among the pedestrians with a nervousness which betokened some secret excitement, and if anything a tendency to be shifty. Soon the cause of his interest was apparent. Just in front of him was a young man in a grey suit and a grey squash hat, taking long strides, and trying to look the energetic Londoner he was not. He carried the long blue envelope beloved of officialdom, and a glance at the stern and bronzed face showed him to be Charles. Soon he turned into one of the tall houses which make up the professional part of the street, and then the bearded foreigner slackened his pace again, resuming his nonchalant air, and began looking into the shop windows. This brought him to a turning down which he slipped, and he had not long passed into the comparative quietude of the side street when he met a friend, tall and greasy and rather sinister looking, with the hang-dog expression of a man who is a failure. The newcomer thrust his head forward as he came up to speak to Dupont, for our friend in the Inverness was none other than he. The conversation was of a private character, for neither spoke above a whisper, though had they shouted at the top of their voices their words would scarcely have been audible above the noise of the passing motor 'buses in the adjacent street. The conversation ended, Dupont disappeared, and it was the tall lean man who now walked slowly up and down Victoria Street, as though waiting for a friend. To the outsider he must have appeared particularly early, or the friend particularly late in coming, for he waited a quarter, half an hour, three-quarters of an hour, ere the person in question turned up. The newcomer was a dapper little man, short and stout, in a grey suit and grey bowler hat, with a white stock tie in which was stuck a large pin. Field glasses and a pair of dazzling white spats completed the get up. At a glance he would have been pronounced sporty, and the two looked a queer couple as they stood still and talked. Presently they went over to an A.B.C., and stayed a long half hour discussing a mild cup of coffee. Whatever the conversation was the little man appeared to be bored, or else he had something on his mind, for he would not always answer his companion's questions, and his small bright eyes would travel hither and thither in all directions, as though he were anxious to think of everything else but the "friend" beside him. Still, even the conversation of the best of friends cannot be continued indefinitely, and after a time the two rose up to go. They made their way down the same side street, as had the French artist, and here they shook hands and parted. The stout, horsey man then retraced his steps, but he seemed to find time hang heavily, for he idled along in a very lethargic and bored fashion. Presently, however, he became more animated, and, approaching the street kerb, made an elaborate bow. It was to an elderly woman driving in a rather smart barouche. She was apparently going to shop at the stores, and in her lap was a little toy spaniel. She was evidently a widow, for she wore thick mourning veils thrown back over her large hat. She called to the coachman to stop, and the carriage was drawn up to the side of the road where the little man with one foot on the step talked for a considerable time. Finally he made another bow and the carriage drove off, to be shortly pulled up again at the stores, where the lady gave her dog to the porter to guard, and disappeared within. Just before she did so, she turned back to see if her acquaintance was still visible, but he had already disappeared. She thereupon turned briskly and entered the lift and asked for the first floor. She spent some time in the jewellery department making a purchase or two, but chiefly examining things and looking about her. Then she adjourned to the restaurant, and taking a seat at a small table in the window, asked for a glass of milk. This she sipped in leisurely fashion, and after it was finished continued to sit with her elbows resting lightly on the table and her fingers playing restlessly with her rings, as though she were deep in thought. Presently she rose and looked out of the window, preserving always the same pre-occupied air. After a time, however, her eyes lost their expression of vacancy and she leaned slightly forward as though watching somebody.

(*To be continued.*)

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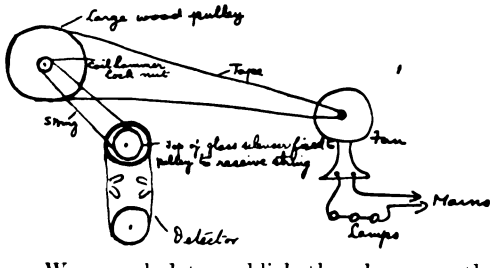
EMERGENCY REPAIRS TO DETECTORS.

A. G. P. writes as follows:

"Last voyage, the spring of my magnetic detector having smashed, and the clockwork therefore being useless, I remedied the accident in the following way: I drove the iron band by means of an electric fan, and had an additional large pulley between the fan and the detector to make the iron band travel slower, but it still travelled too fast, so I experimented with various lamps until I got the right resistance in the fan to make the iron band go at the proper speed. I found that I got much better signals with the band travelling about half as fast again as it would usually when driven by clockwork. I may add that I did not get the slightest induction in my 'phones from the fan. I am sending this note because I think it might be a good hint to other operators who have the misfortune to have their detectors breaking in the middle of the ocean. Accompanying this is a rough diagram."



We are glad to publish the above, as the method adopted shows a desirable ingenuity and resource. An electric fan is a most useful piece of apparatus in an emergency. We have seen a 100-kw. station transmitting quite happily with a signalling-switch made out of such a fan and some hack-saw blades. With regard to the stronger signals produced by an increased speed of band, this is a phenomenon which is met with from time to time. The mass of iron passing per second through the coils of the detector should, strictly speaking, be adjusted to a large number of conditions, including the strength of the magnets and their distance, the actual strength of the signals, and their frequency. The standard speed is the one which has been found to give the best results with average signals; so, under some conditions, better results can be obtained by an alteration in speed.

ATMOSPHERICS.

W. P. S. writes:

"For some time past I have been making observations of the phenomenon known to the wireless telegraphist as atmospherics, and of atmospheric conditions generally as affecting radiotelegraphy; but such isolated observations from a moving station are of less value relatively than meteorological observations from one point only would be. One very striking occurrence came under my notice, of which I have never seen any mention in print, though possibly it has been observed before. When working comparatively long distances at night, and particularly in the Southern Indian Ocean, we are often troubled by the strength of the received signals varying greatly, one moment being quite strong and in a few seconds weakening to such an extent as to be nearly or quite inaudible. One night while off the New South Wales coast all signals were varying in this manner, and for a few minutes I could hear two stations working. First the signals from one station weakened while the signals from the other came in stronger. Then in a few seconds the condition was reversed, the one being strong and the other weak. The whole process was repeated several times within a minute. It gave me the impression that the wave-conducting medium was surging rapidly to and fro, thus making the distance to be travelled by the waves greater or less and consequently altering the strength of the received signals.

"It has occurred to me that a systematic and world-wide series of observations of atmospheric conditions as regarding radiotelegraphy and a comparison of these observations with meteorological and solar phenomena would lead to interesting and valuable results. The scientific world is greatly interested in the propagation of electro-magnetic waves and the medium through which these waves are transmitted. It would, therefore, seem that the production of some such systematic observations would be welcome to them. The Marconi Company alone, with its vast army in every part of the world, could undertake to collect such information. I believe that the results obtained would fully justify the inauguration of such a systematic survey."

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Lessons from the Balkan War

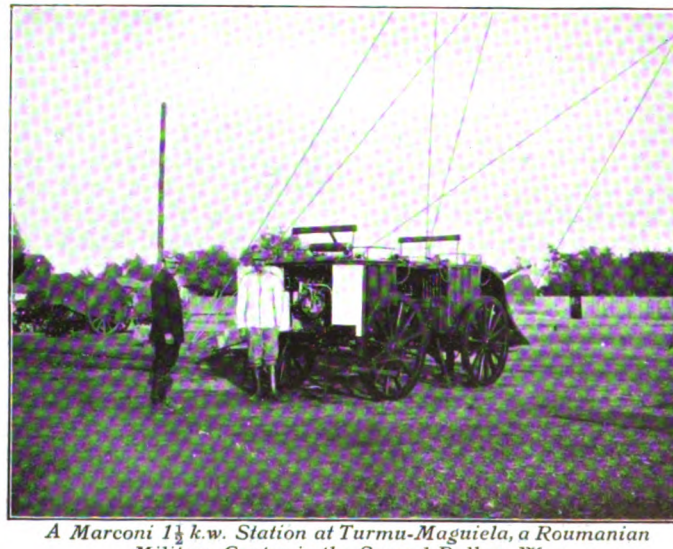
WIRELESS IN WARFARE. FIELD STATIONS FOR THE ROUMANIAN ARMY. THEIR INFLUENCE IN THE WAR.

ROUMANIA was foremost among the Allies in the second Balkan War as regards her wireless equipment. To an already excellent service she had recently added fourteen 1½-kw. stations and six knapsack stations. All the arrangements for the equipment were in the hands of the Marconi Company, and the whole of the material used was shipped direct from their works in England.

A group of General Staff Officers of the Roumanian Army at Plevna with the Marconi Station. The Officers include Lt.-Colonel Mihail, Commandant Jonescu, Captain Stoenescu and Sub.-Lt. Vasiliu.

Extensive trials were made of the apparatus as soon as it was unpacked, and before transmission to the seat of war. One of the stations was set up just outside Bucharest, and the other points of communication were Sinaia and Buzen, the three forming as it were the apices of a triangle, with the distance between each practically 120 kilometres. These stations were in constant communication with each other for over twenty-four hours, and throughout the time there was little divergence in the strength of the signals.

As a test for the ability of the stations to stand rough usage, the station at Buzen was sent by road from Bucharest—a journey fraught with many dangers to delicate machinery, for in places the road is little more than a cart track, but the fact that communication was set up within an hour of its arrival speaks for itself. As soon as these tests were completed the station at Buzen was removed to Barlad, where it had been arranged to open communications with Bucharest. This was successfully accomplished, and the distance covered was about 250 kilometres,



A Marconi 1½ k.w. Station at Turmu-Maguiela, a Roumanian Military Centre in the Second Balkan War.

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or 150 English miles. One of the stations was stationed at Plevna, and the others were directed to the chief centres of military activity.

Leeds "Wireless" Troops for the Army Manœuvres.

THE Northern Command Telegraph Companies (Leeds Engineers) were ordered to supply a complete wireless detachment for the army manœuvres. Three years ago the Airline Company took part in the big manœuvres, and this was followed in 1911 by a most successful selection from the Cable Company, whilst last year the present adjutant (Capt. T. H. L. Spaight) acted as O.C. Signals of a composite signalling detachment, which included a few picked members of the Northern Command.

It was the original intention of the War Office authorities to call upon the newly-styled Northern Signal Companies for a detachment from each of the three units, but it was eventually decided that the Wireless Company only should take part in the manœuvres in the Northampton district. This company consisted of one officer in command (Capt. R. L. Denham), 16 other ranks, 11 horses, with a wireless waggon equipment and a light waggon. The detachment left Leeds for Daventry, where they joined the White (defending) force. They were attached to the army troops of the army headquarters at the advanced base, and returned to Leeds a week later.

Two other wireless waggon sets and two pack sets were also attached to the defending force, but the Leeds detachment worked its wireless station on the longest length of waves—viz., 850 metres—the other being fixed at 750 and 500 metres respectively. It is generally recognised that the efficiency of the Leeds "Wireless" Company is of a very high order. The class of work carried through at Yarmouth last year and on the Yorkshire Wolds in August, where many previous records were easily beaten, gave great satisfaction to the West Riding Association at York, and also to headquarters.

With a total established strength of 436 of all ranks and 12 supernumerary motor-cyclists, the actual numbers at the end of last month reached 364.

Capt. Spaight, whose extended period of service as adjutant recently expired has just been granted a further extension of six months.

Antarctic Journalism

Interesting news has come from the Antarctic, *via* Wireless. Dr. Mawson, the leader of the Antarctic Expedition which was sent out by the Australian Government, and which is making extensive explorations in Adelie Land, has just issued the first number of a monthly journal entitled the *Adelie Blizzard*. This is the first enterprise of such a nature to be undertaken in the Antarctic, and is no insignificant publication either, for the *Adelie Blizzard* can boast 28 pages of matter.

The 5-kw. Marconi station, which was erected at Port Stanley, Falkland Islands, is frequently in communication with the station at Cape Sao Thome, Brazil, a distance of 2,200 miles. As an example of detector efficiency, it may be mentioned that Port Stanley is able to hear Lima, Peru, every night, the distance being 3,000 miles. This achievement is all the more remarkable, when we remember that Lima is situated immediately under the Andes, and screened from Port Stanley.

At a recent conference between J. Daniels, the Secretary of the Navy, and Captain George R. Clark, Commandant of the United States naval training station at Great Lakes, Ill., it was decided that a high-power radio station and plant should be erected at the latter place. The Great Lakes station is near Lake Bluff, Ill., on the shore of Lake Michigan, about 30 miles north of Chicago.

The French Army manœuvres are being held this year in the south of France in the region between the Garonne and the Baise, one of its tributaries.

The two opposing armies will be commanded by General Pau and General Chaumer. The Air Services will be used to the fullest extent by both armies, and a trial is to be given to the organisation for distributing by wireless from the Eiffel Tower forecasts of weather conditions for the guidance of the Air Services.

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Administrative Notes

New British Station.

A Post Office wireless coast station has been erected at Fishguard and opened for commercial work, from midnight, Monday, September 8th. The station at Rosslare was closed on and from that date, and the staff transferred to Fishguard. The call signal of the Rosslare station, namely, "GRL," is used for the new station at Fishguard.

* * *

United States Naval Stations.

THE following Naval Radio Shore Stations in the United States will now transmit messages at the rate of 6d. per word cable count, with a minimum charge for ten words: Charleston, South Columbia; St. Augustine, Florida; Jupiter, Florida; Key West, Florida; Pensacola, Florida; Guantanamo Bay, Cuba; San Juan, Porto Rico; Colon, Canal Zone; Balboa, Canal Zone; Taloosh Island, Washington; North Head, Washington; Cape Blanco, Oregon; Eureka, California; Point Arguello, California; San Diego, California.

* * *

School of Wireless Telegraphy for Spain.

The Spanish Government has recently passed a Bill into law which provides for the organisation of a school of wireless telegraphy with the object of instructing pupils, whether already in the telegraph service or not, in the theory and practice of radiotelegraphy, and to fit them for service either on shore or ship stations of private companies.

There will be three courses of study, the first one lasting six months. The pupils will then have to pass a test consisting of the transmission of at least 20 words per minute for not less than five nor more than ten minutes, with an allowance of 1 per cent. of uncorrected mistakes.

The second course will last three months, and will comprise a course of study of the apparatus used in radiotelegraphy, the tuning of same for different wave lengths, commutation, etc., the regulations regarding the exchange of wireless messages, and the adjustment of slight irregularities.

A higher and final course will also be given for those wishing to further pursue their studies. Foreign languages also figure in the curriculum of the school.

* * *

Amateur Regulations in Germany.

Regulations have been adopted in Germany concerning the installation and working of wireless telegraph receiving stations. The license, which may be revoked at any time, applies only to the use of stations for receiving time signals from Norddeich, which uses a wave of 1,650 m.

The installation must fulfil the following technical requirements:

(*a*) The receiving apparatus shall be adjusted so that the owner of the station may alter the syntonisation only within the immediate vicinity of the prescribed wave-length. The adjustable wave-lengths shall not differ by more than 5 per cent. above or below the prescribed wave-length.

(*b*) The antenna shall not be larger than is necessary for the intended reception.

(*c*) The single parts of the oscillatory circuits, also of the antenna circuit, shall be connected firmly and permanently with each other by being soldered together; exceptions are only admissible at the connecting terminals of the detectors and of the telephone receivers.

(*d*) The soldered joints shall be enclosed in casing containing all the parts of the apparatus, and this must be sealed, so that only the handle of the tuning device and the connecting terminals of the detectors and of the telephones are accessible to the owner. For the connection of the antenna wire, a sound insulating wrapper shall be used.

(*e*) No subsequent connection of circuits or tuning devices shall be permitted.

The controlling officials of the Imperial Telegraph Administration, of the Imperial Naval Administration, and of the Administration of the Army are permitted at any

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time to enter the rooms where the apparatus is kept, and to inspect all the arrangements appertaining to the installation. The licensee is under an obligation not to divulge signals which he may intercept, and the license may be withdrawn if this regulation is not observed. The station must be removed or the working suspended at such times as may be required by officials of the aforenamed departments.

* * *

Compulsory Wireless Law in Portugal

The Draft Law relating to the compulsory equipment of ships with wireless telegraphy, which was presented to the Portuguese Parliament on June 25th by the Minister of Marine, and which was forthwith approved, provides (Article 1) that within three months of the "approval of the Regulations for the execution of the present law no Portuguese steam vessel, with accommodation for more than fifty passengers (including crew), shall be permitted to sail from any port without having installed a wireless telegraphic apparatus, in good working order, and capable of dispatching and receiving radio-telegrams within a radius which must never be less than 100 miles." Steamers trading between ports situated at distances of less than 200 miles apart are exempt from the operation of this law. In the case of steamers trading with colonies that have coast stations, but which only occasionally return to the home waters, the installations must be completed within six months. The station must be in charge of one or more qualified telegraph operators, who work under the supervision of the captain and carry out such instructions as he may consider desirable for the good working of the service (Article 3). The captain of the vessel is liable to a heavy monetary fine and the suspension for one year of his master's certificate for failure to comply with Article 1, and to a fine and imprisonment in the case of failure to comply with Article 3. Should a vessel meet with disaster, or be lost, as a result of lack of vigilance on the part of the telegraph staff, and if this fault be due to any negligence on the part of the captain in carrying out the requirements of the Act relating to radio-telegraph service, it shall be punished by a fine which may be accompanied with the suspension of his master's certificate for from one to five years, according to the seriousness of the disaster. All apparatus intended for Portuguese vessels will be exempt from Customs and Municipal duty.

* * *

New Zealand Wireless Stations

An interesting portion of the report for 1912 of the New Zealand Post and Telegraph Department, which was circulated recently, deals with the development of wireless telegraphy in New Zealand. The report, after dealing with the opening during the year of stations on Tinakori Hills and on the chief post office, Auckland, and the equipment of the steamer *Tutanegai*, goes on to say: "The erection of the Chatham Islands wireless station of 2½ kw. is proceeding, and communication will be established shortly. The high-power station at Awanui of 30 kw. has been completed It will be capable of communicating with Sydney at any hour. This station is provided with a tower 394 feet in height, from which an umbrella-shaped aerial spreads from summit to base over an area of about 90 acres. A similar station at Awarua, near Bluff, is also completed. These stations are undergoing departmental tests. The report adds:

"At the International Radio-telegraphic Convention at London, in June, 1912, the question of the regulation of wireless communication was reviewed. The convention emphasised the need of a closer observance of the regulation requiring ships to communicate with the nearest coast station so as to minimise the interference peculiar to wireless communications and to permit of a greater number of radio-telegraphic messages being exchanged simultaneously. The use of minimum power for the distance to be covered has also been enjoined for the same reason. In exceptional cases maximum power may be used and a station other than the nearest one may be communicated with if a special wave-length be employed. The general trend of the amended regulations is in the direction of limiting long-distance working from one ship to another and between a ship and a coast station in order to circumscribe the area of disturbance. Ships are to be graded in three classes, and to observe prescribed hours of attendance, principally to ensure distress signals being observed. The amended regulations come into force in July, 1913."

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Maritime Wireless Telegraphy

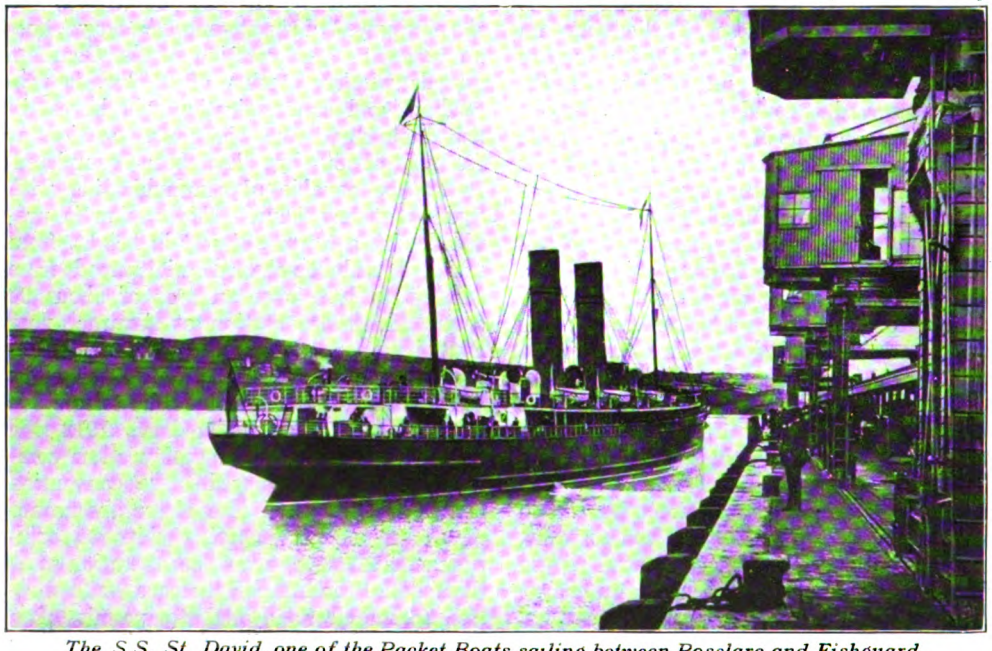
THE tall masts now fitted in the larger racing yachts are popularly known as "Marconi" masts, because of their resemblance to wireless telegraph masts. We understand that the first was fitted last year in the Nicholson-designed *Istria*, 15-metre cutter. The elongation of the top-mast permits of the top-sail yard being entirely dispensed with. The upper section of the top-mast is fitted into the mid-section, which in turn is fixed into a socket in the mainmast proper. While "Marconi" masts have been very generally adopted by the larger British racing yachts, it is not yet finally demonstrated that the undoubted advantages they afford in certain circumstances more than compensate their drawbacks in others. The 19-metre yacht *Norada*, so successful at the Clyde Regattas, though her "Marconi" was simply added to her previously fitted top-mast, has now removed that extension, and carries her jackyard top-sail with the top-sail yard, as formerly.

* * *

The port authorities at Rotterdam have just installed a wireless station for the use of the river police, the apparatus being fitted at the central bureau and on the police steamers. The object of the installation is to facilitate the rapid despatch of assistance in the event of collisions or accidents, and to aid in the pursuit of river pirates. It will be possible to communicate with the river police boats as far up as Maassluis.

* * *

The steamer *Matunga* recently arrived at Sydney from New Guinea. The passengers, speaking of the fire which occurred on the *Matunga* on the passage from Cairns to Port Moresby, paid a tribute to the skill of the captain, officers, and engineers. There was no panic on board, and many of the passengers were unaware of any untoward incident until the danger was passed. The wireless operator, at the first word of warning, was at his post, and communicated with Port Moresby, where boats were in readiness to come to the *Matunga* if required. Fortunately the outbreak was suppressed with only the loss of a portion of the mails. As a mark of recognition of the skill displayed in getting



The S.S. St. David, one of the Packet Boats sailing between Rosslare and Fishguard, recently equipped with wireless.

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the fire under control, the passengers presented gold medals to the officers, including the wireless operator.

* * *

An addition to the facilities at Fishguard Harbour, which will be of great convenience alike to the travelling public and the Great Western Railway Company, came into operation on September 8th, when a new wireless telegraph station, which has been erected on the top of the cliffs, near the Harbour Village, was opened. The station is the outcome of an arrangement under which the company have constructed the building and the Post Office equipped it and undertake the working of it. It consists of a one-story building containing a power and instrument room, together with accommodation for the staff. The high mast, reared above the cliffs, forms a landmark for miles around. The equipment of the station is on the Marconi principle, with instruments capable of transmitting and receiving messages within a radius of 500 miles, the necessary power being obtained from the Great Western Railway Company's generating station at the harbour. Particulars of the station appear on page 450.

With the provision of the land station, opportunity has also been taken to equip the company's turbine steamers, *St. David*, *St. Patrick*, and *St. Andrew*, with wireless apparatus. The Marconi system is adopted with a range of 100 miles. The plant is installed in a cabin on the bridge deck of the boats, so as to be readily accessible to passengers desirous of despatching messages.

* * *

The s.s. *Krakatau*, of the Stoomvaart Maatschappij Nederland, which stranded on the Misniaria reef, near Jeddah, suffered severe damage. The bow was buckled, and hold No. I leaked. The 1,618 passengers were removed from the ship by a vessel of the same line which received the call for help by means of wireless telegraphy. The *Krakatau* is a cargo boat fitted with ½-kw. Marconi station.

* * *

The value of wireless telegraphy for summoning medical aid in cases of illness on board ship is being more and more appreciated. Only recently the operator on the S.S. *Empress of Asia* reported a case where a fireman on board the White Star cargo steamer, the *Cevic*, was medically attended by the doctor on his own vessel. On the receipt of information regarding the symptoms of the patient and the contents of the *Cevic's* medicine chest, the doctor diagnosed the illness, prescribed the proper medicines, and continued to watch over the invalid's welfare till his aid was no longer required.

* * *

Another case of wireless aid in illness is that of Lady Fry, widow of the late Sir Theodore Fry, who was taken ill on the Royal Mail yacht *Arcadian*, when returning from a cruise in the Norwegian Fjords. In response to a wireless message from the *Arcadian*, when nearing the English coast, Lady Fry's physician and nurse met the vessel on arrival, and an operation was immediately performed which has been completely successful.

* * *

One of the engineers of the White Star liner *Tropic*, bound from Liverpool to Australia, was recently landed at Plymouth for medical treatment. He had a splinter of steel in his eye. Soon after the accident occurred the *Durham Castle*, which was homeward bound from South African ports to Plymouth, was found to be in the vicinity, and in response to the wireless call the liner's captain agreed to take the injured man home to England, so that the hospital treatment could be obtained at the first possible moment.

* * *

Lord Haldane made conspicuous use of wireless telegraphy when returning from America on board the *Lusitania*, for in response to an inquiry forwarded by the *Daily Mail*, he made the definite statement that his remarkable speech on "Higher Nationality —a Study of Law and Ethics," before the American Bar Association of Montreal, was intended to be a definite statement of Great Britain's policy and as such to be accepted throughout the world. The exact message published in our contemporary ran :

[BY WIRELESS.]

SS. *Lusitania*, Thursday.

To the Editor of the "Daily Mail."

A speech delivered by a Minister of the Crown communicating a message from his Sovereign to the peoples of America and Canada cannot be regarded as the speech of a private person. HALDANE.

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Collection of Meteorological Data

NEW WIRELESS SERVICE

ON August 1st the Scheveningen Port Coast station inaugurated a daily service of meteorological data which is transmitted to ships on request. The telegram contains the data collected from the meteorological stations: Helder, Flushing, Gris Nez, The Hague (with an indication of the state of the sea); Yarmouth, Shields, Skudesnaes, Sylt (without indication of the state of the sea).

The data given by each station consist of two groups of 5 figures made up on the basis of a table BBBWW SHTTG.

BBB gives the atmospheric pressure in millimetres and tenths of millimetres, omitting the hundreds figure of the millimetres;

WW shows the direction of the wind according to the compass-card (see table A below);

S shows the force of the wind according to the Beaufort scale (see table B below);

H gives the state of the sky and the weather according to the code of table C below;

TT gives the temperature in degrees Centigrade. Temperatures below zero are indicated by the addition of the number fifty to the number showing the degrees of frost, so that, for example, a temperature of —14 degrees is shown as 64;

G shows the state of the sea according to table D below. When the state of the sea is not shown, the second group of the station in question contains only four figures.

Where necessary, the groups of figures are followed by an advice regarding the storm signal.

TABLE A.

02 = NNE	18 = SSW
04 = NE	20 = SW
06 = ENE	22 = WSW
08 = E	24 = W
10 = ESE	26 = WNW
12 = SE	28 = NW
14 = SSE	30 = NNW
16 = S	32 = N

00=calm.

TABLE B.

0 = nil or calm	5 = fairly strong
1 = light air	6 = strong
2 = light breeze	7 = very strong
3 = gentle breeze	8 = gale
4 = moderate	9 = hurricane

TABLE C.

0 = fine	5 = rain
1 = slightly cloudy	6 = snow
2 = cloudy	7 = misty
3 = very cloudy	8 = fog
4 = overcast	9 = storm

TABLE D.

0 = calm	5 = rough
1 = very smooth	6 = very rough
2 = smooth	7 = high
3 = slight	8 = very high
4 = moderate	9 = phenomenal

GOVERNMENT STORM WARNINGS BY WIRELESS.—The United States Agricultural and Navy departments are now sending wireless storm warnings and general weather forecasts to ships at sea. Bulletins are sent out from the navy wireless stations at Radio, Va., and Key West, Fla., a few minutes after 10 o'clock every night. These bulletins consist of two parts. The first gives, in code letters and figures, the actual weather conditions, at 8 p.m. (75th meridian time), at Sydney, Nova Scotia, Nantucket, Atlantic City, Hatteras, Charleston, Key West, Pensacola, and Bermuda, followed by a special forecast of the probable winds to be experienced one hundred miles off shore. The second part gives the storm warnings covering a period of forty-eight hours from the time of issue, and at the end of the forecast is given a statement of the location and movement of any barometric depressions that may be likely to affect the winds over the ocean. The broadcast distribution of wireless weather bulletins by the stations at Arlington and Key West is a part of the purpose for which these stations were originally designed.

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Contract News

Orders have been received during the past month to equip the following Vessels with Marconi Apparatus.

Name of Vessel.	Owners.	Installation.	Remarks.
Aquitania	Cunard Steamship Co. ..	5 kw. and emergency	The latest of this company's magnificent Atlantic liners. It is still in process of building.
Flintshire	R.M.S.P. Co.	1½ kw. and emergency	Destination undecided.
Garm	Norwegian Government ..	,,	A Norwegian torpedo-boat destroyer.
Salmo	Thos. Wilson, Sons & Co. ..	,,	On passenger service between Grimsby and Gottenburg.
Viking	Amazon Telegraph Co ..	,,	Cable ship.
Desabla	Andrew Weir & Co. ..	,,	Transport vessels on world-wide service.
Barneson	,, ,, ..	,,	
Star of India	J. Corrie & Co.	,,	These transport vessels carry on an extensive service between England, Australia, and New Zealand, touching at all the most important ports, as well as at the Falkland Isles.
Star of Australia ..	,, ,, ...	,,	
Star of Victoria ..	,, ,, ...	,,	
Star of England ..	,, ,, ...	,,	
Charles E. Harwood ..	Petroleum Carriers, Ltd. ..	½ kw. and emergency	A further order from this important line of petroleum carriers.

The Société Anonyme Internationale de Télégraphie sans Fil have equipped the following Vessels.

Ship.	Owners.	Installation.	Call Letters	Remarks.
Van Lansberge	K.P.M.	1½ kw. and emergency	PMG	Registered at Batavia.
Westerdijk	Nasm	,,	PGZ	Registered at Rotterdam.
Kiruna	R.L.O.	,,	SFN	Registered at Pitea.
Bergensfjord	Norske Amerika Linie ..	,,	LFB	Registered at Christiania.

The following Vessels have been equipped with Marconi Apparatus since the last issue of the *Wireless World*.

Name of Vessel.	Owners.	Installation.	Call Letters.	Remarks.
Alsatian	Allan Steamship Co. ..	1½ kw. and emergency	GYH	Passenger vessel sailing between Liverpool and Montreal.
Barala	British India Steam Navigation Co.	,,	GCM	Trading round Indian Coast with limited number of passengers.
Andes	Royal Mail Steam Packet Co.	,,	MRQ	Passenger vessel recently constructed for sailing between Southampton and Buenos Aires.
San Gregorio	Eagle Oil Transport Co. ..	,,	MAC	Oil transport.
Somali	Peninsular & Oriental ..	,,	MIW	Transport on Admiralty Service, running between Southampton and Hong Kong.
Kandahar	Bucknall Steamship Lines ..	½ kw. and emergency	MAB	Transport vessels with world-wide service.
Koranna	,, ,, ,, ..	,,	GYV	
St. Patrick	The Great Western Railway	,,	GYM	Passenger and cargo vessels plying between Fishguard and Rosslare.
St. David	,, ,, ,,	,,	GYL	
St. Andrew	,, ,, ,,	,,	GYJ	
Vitruvia	Gow, Harrison & Co. ..	,,	GYS	Transport vessel on world-wide service.
Edward L. Doheny ..	The Petroleum Carriers, Ltd.	,,	GYR	Tank steamer sailing to South American ports.

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INSTRUCTION IN WIRELESS TELEGRAPHY

The Wavemeter

(Sixth Article.)

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appears on page 461.]

42. WE showed in our last article how, when a closed oscillating circuit is coupled to an open oscillating circuit for the purpose of exciting the latter, the result was the production of two distinct waves, one longer and one shorter than the normal wave-length of either circuit taken separately, and that the closer two circuits were coupled together, the greater the difference between the two resulting wave-lengths.

For convenience the degree of coupling between two oscillatory circuits is expressed as a percentage of its full coupling.

If two oscillatory circuits were fully coupled, the two resulting waves would be so far apart that the lower wave would be sensibly zero and the only wave-length left would be $\sqrt{2}$ times the wave-length of the two circuits taken separately.

In practice such conditions do not occur, it being usual to have a coupling of not more than about 15 per cent. between the primary oscillating circuit and the aerial circuit.

As a matter of fact, with commercial stations, a regulation has been laid down by the International Wireless Convention that no station is allowed to use a closer coupling than 15 per cent.

43. **Calculation of the Degree of Coupling.**—Since the difference between the two resulting wave-lengths of coupled circuits depends upon the degree of coupling between the circuits, it follows that we can calculate the coupling if we know the values of these two waves, and the following formula, although not exact, will give a very near approximation of the percentage of coupling.

If k = percentage of coupling between two circuits and λ 1 is the wave-length of the longer of the two resulting waves, λ 2 the wave-length of the shorter of the two resulting waves, and λ 0 the wave-length of each of the circuits taken separately, then

$$k = \frac{\lambda 1 - \lambda 2}{\lambda 0} \times 100$$

Let us apply this formula to a practical case.

On a certain vessel a wireless installation had been fitted, and when the primary oscillating circuit was coupled to the aerial (each having been previously tuned separately to 600 metres) it was found that the resulting wave-lengths were 570 metres and 630 metres respectively.

From this it can be calculated that the

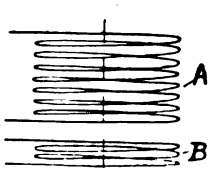

Fig. 1.

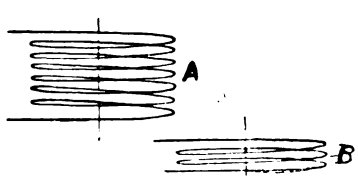

Fig. 2.

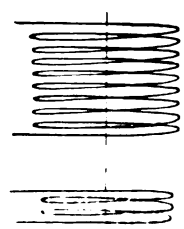

Fig. 3.

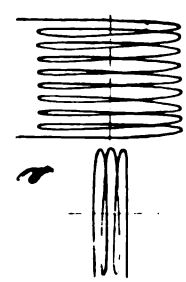

Fig. 4.

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coupling between the two circuits was 10 per cent.

$$k = \frac{630 - 570}{600} \times 100$$

$$= \frac{60 \times 100}{600} = 10$$

44. **Methods of Varying the Couplings between the Inductance Windings of two Oscillatory Circuits.**—The method most commonly used to vary the coupling between the primary circuit and the aerial circuit of a transmitter, is to **slide the secondary winding away from the primary winding.**

This method is illustrated in Figs. 1 and 2, where A is the inductive winding of the open oscillating circuit, that is to say, the jigger secondary, and B the inductive winding of the closed oscillating circuit, that is to say, the jigger primary.

When one of these two coils is immediately above the other, as shown in Fig. 1, the coupling between the two is at its maximum, but when the secondary winding is moved until it occupies a position near the edge of the primary winding, as shown in Fig. 2, the coupling is at its minimum.

Another method of adjusting the coupling between two circuits is to **alter the relative angular position between the axes of the two windings.**

When these two axes are in line, the coupling is at its maximum, and when they are at right angles to one another the coupling is at its minimum.

This method is illustrated in Figs. 3 and 4. In Fig. 3 the axes of the two coils are in line, and therefore the coupling is at its maximum, whereas in Fig. 4 the axes of the two coils are at right angles to one another, and therefore the coupling is at its minimum.

45. **The Wavemeter.**—The wavemeter is an instrument, as its name implies, used **for measuring the length of the wave or waves emitted by a transmitter or other oscillating circuit.**

It consists essentially of a closed oscillatory circuit whose wave-length can be varied over a large range of values by the adjustment of the inductance or the capacity which together form that circuit.

In practice it is usual to vary only the capacity of the circuit, keeping the inductance a constant value throughout. This for various practical reasons is found to be more convenient than adjusting the inductance. Fig. 5 shows such an oscillatory circuit, where L is the fixed inductance and C the variable condenser.

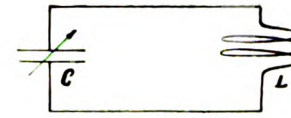

Fig. 5.

We have already learnt that **the wave-length of an oscillatory circuit depends upon the product of the capacity and the inductance of that circuit;** it follows, therefore, that **as we increase or decrease the capacity of the adjustable condenser, so do we increase or decrease the wave-length of the circuit.**

Practical considerations limit the maximum and minimum values of the capacity to which the condenser can be adjusted, and therefore limit the maximum and minimum wave-lengths to which the circuit can be tuned.

An adjustable condenser of convenient size will allow the wave-length of the circuit to be adjusted to about eight times its minimum wave-length; that is to say, if the inductance is so wound that the minimum wave-length easily obtainable is say 100 metres, the maximum wave-length to which the circuit can be adjusted will be about 800 metres.

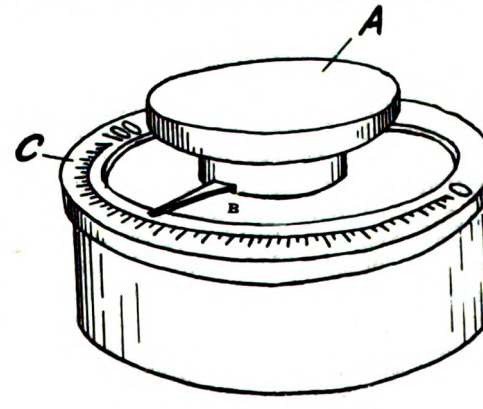

Fig. 6.

An illustration of a variable condenser is shown in Fig. 6. The principle on which it is constructed will be described later, but for the present it is sufficient to know that its

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capacity is varied by turning the handle A. Fixed to this handle is a pointer B, which passes over a scale, C. This scale is carried half-way round the circumference of the condenser, and is divided into a number of small divisions which are marked from 0 to 100. When the handle of the condenser is so turned that the pointer indicates the figure 0, the capacity of the condenser is at its minimum, and as the pointer passes up the scale the capacity of the condenser increases proportionately until it arrives at its maximum capacity when the pointer indicates the figure 100.

It is not, of course, necessary when using the instrument to know what are the values of the capacity corresponding to the different scale readings of the condenser. It is only necessary to know what are the values of the wave-length of the circuit corresponding to the various positions of the condenser. In other words **the condenser should be "calibrated" in wave-lengths.**

With each instrument a curve or chart is supplied which gives the values of the wave-lengths of that particular instrument for every position of the condenser.

By the use of this chart we can either set the condenser so that the circuit is adjusted to any desired wave-length within the limits of the instrument, or *vice versa*, we can find out to what wave-length the instrument has been adjusted by referring first to the condenser reading and then reading off the chart the value of the wave-length corresponding to that condenser reading.

46. **Method of Using the Wavemeter.**—The method of using the wavemeter for measuring the wave-length that is being emitted by, say, the aerial of a wireless telegraph station, is as follows: .

The wavemeter is first brought sufficiently near to some part of the aerial circuit, preferably near the earth wire, so that the oscillatory currents passing up and down the aerial induce similar currents in the inductance coil of the wavemeter. The condenser of the wavemeter is then adjusted until the wave-length of its circuit is in tune with the wave emitted by the aerial.

By noting the scale reading to which the condenser is adjusted, and by referring to the calibration chart of the instrument, we immediately find the value of the wave-length to which the wavemeter has been adjusted, and since this is in tune with the aerial, this value is also the value of the wave-length of the aerial.

47. **Method of Telling when the Wavemeter is in Tune with the Circuit being Measured.**—In carrying out this operation there is one point that we have not yet explained. **How are we to know when the wavemeter is in tune with the aerial?** To explain this we must refer back to paragraph 36, in which we showed that when two oscillatory circuits are coupled together, one of which is set oscillating, similar oscillations are induced in the second circuit, provided that two circuits are in tune; that if they are out of tune, although a certain amount of current is still induced in the second circuit, this current will be comparatively feeble and erratic, but will rapidly rise as the circuits are brought nearer and nearer into tune, reaching a maximum when the two circuits are quite in tune.

When we bring the wavemeter near the aerial, we are in effect coupling the wavemeter circuit to the aerial circuit, and we shall obtain similar phenomena.

It follows, therefore, that the aerial currents will induce similar currents in the oscillatory circuit of the wavemeter, and that if we vary the adjustment of the condenser of the wavemeter circuit, we shall come to a point when this circuit is in tune with the aerial, and we shall then get a maximum current induced in the circuit.

48. **The Use of Telephones as Current Detectors.**—We have, therefore, only to find a means of measuring the current in the wavemeter circuit in order to tell when it is in tune with the aerial.

It is not necessary to know the actual value of the current, but only its comparative value, so that a detector which will respond proportionally to the amount of current passing through it will suit our purpose.

The telephone receiver is a very suitable instrument for this purpose; for one thing, it is extremely sensitive to even the very smallest current passing through it, and for another thing by judging the loudness of the sound in the telephone, we can judge the comparative amount of current passing through it.

There are two conditions, however, that

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are necessary for the use of a telephone as a current detector; the first is, that the current passing through it must be an **interrupted** current in order to produce a buzz instead of a single click, and the second is that the current passing through it must either be a **uni-directional current** or a **low frequency alternating current.** A high frequency alternating current will not affect the telephones.

The current induced in the wavemeter is a high frequency current, and, therefore, unless it can be converted into a uni-directional current, or a low frequency alternating current, it will not affect the telephones.

49. **The Use of Crystals.**—It is found that certain crystals, such as carborundum, have the property of rectifying high frequency oscillating currents. They really act as non-return valves, allowing the current to pass through them in one direction only, which is equivalent to converting the high frequency current into a uni-directional current.

These crystals, however, have an extremely high resistance, and we showed in paragraph 38 how the effect of putting a high resistance in an oscillatory circuit was to destroy the oscillatory properties of that circuit. For this reason the crystal cannot be inserted directly in the oscillatory circuit, but a little thought will show us that it is not necessary to insert either the crystal or the telephones directly in the oscillatory circuit.

The current in the oscillatory circuit, as we know, charges up the condenser of that circuit to a certain voltage, and the voltage to which it is charged is proportional to the current, that is to say, the greater the current

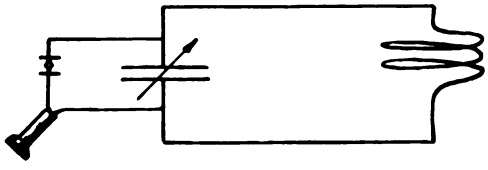
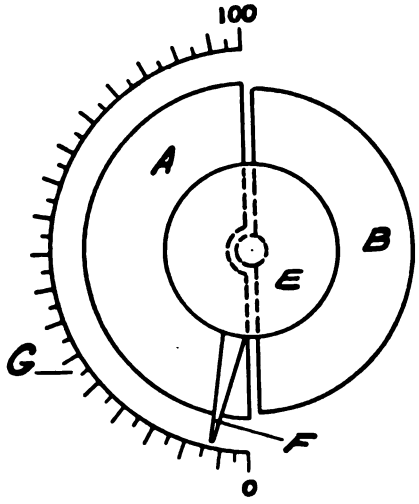


Fig. 7.

induced in the inductance coil the higher the voltage to which the condenser will be charged.

If, therefore, we place our crystal in series with the telephone **across** the condenser, as shown in Fig. 7, we shall not in any way interfere with the oscillatory properties of the oscillatory circuit, but we shall get a certain current passing through the crystal and the telephones, the amount of which will be proportional to the voltage to which the condenser is charged, and therefore proportional to the amount of current induced in the oscillatory circuit. Moreover, the crystal will rectify this current, so that in effect we shall get a direct current passing through our telephones. This current also will be an interrupted current, the number of interruptions per second being the same as the number of sparks per second which the induction coil exciting the aerial is producing. We shall therefore get a buzz or note in the telephone corresponding exactly to that produced by the spark of the transmitter, and proportional in its loudness to the amount of current induced in the inductance coil of the wavemeter.

The loudness of the sound in the telephones will then depend upon two things:



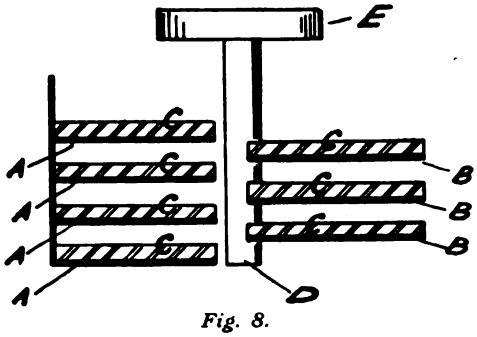


Fig. 8.

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(1) the nearness of the inductance coil of the wavemeter to the aerial, and (2) the closeness of the wave-length of the wavemeter circuit to that of the aerial circuit which is exciting

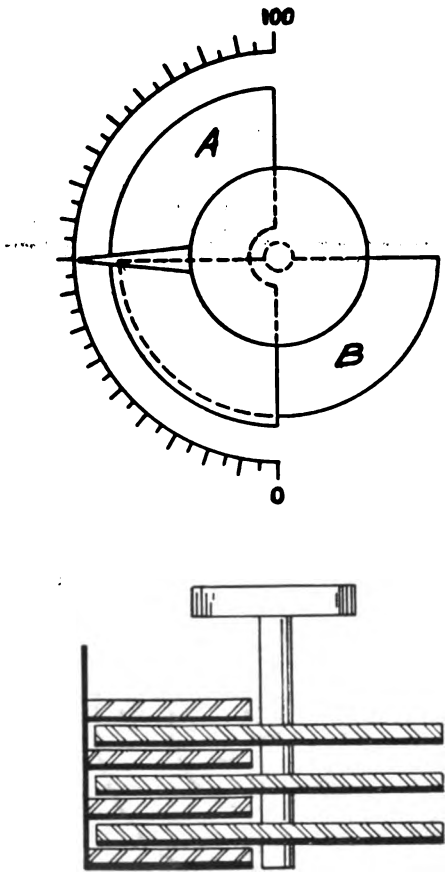


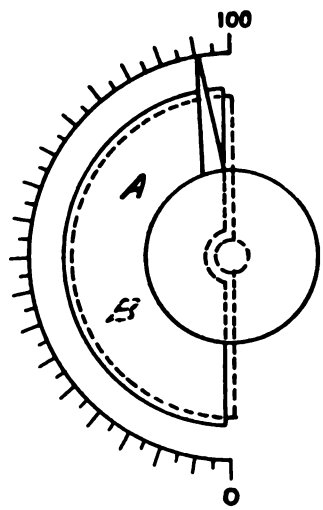
Fig. 9.

it. Of these the first is kept constant by not altering the position of the wavemeter while the test is being made. It is clear, therefore, that if we vary the adjustable condenser of the wavemeter circuit, and at the same time listen to the sound in the telephones, when this sound is loudest, the wavemeter circuit is in tune with the aerial, and by noting the position of the condenser thus obtained, and referring this reading to our calibration chart we find the value of the corresponding wave-length, and therefore the length of the wave emitted by the aerial.

50. **Construction of an Adjustable Condenser.**—The construction of an adjustable condenser is illustrated in Figs, 8, 9, and 10 A number of semi-circular metal plates, A, are connected together, and held rigidly parallel to one another and at a sufficient distance apart to allow the second set of metal plates, B, to pass in between them. Fixed to the upper sides of both the A plates and the B plates are ebonite plates, C, of the same shape.

The second set of metal plates, B, are held together on a spindle, D, which can be rotated by the handle, E, which is fixed to one end of the spindle.

The fixed plates, A, form one side of the condenser, and the movable plates, B, form the other side of the condenser, the



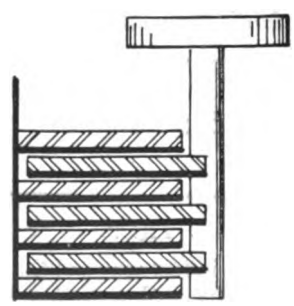


Fig. 10.

dielectric of the condenser being formed by the ebonite plates, C. When these plates are in the positions shown in Fig. 8, the capacity of the condenser is practically zero, but if

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the movable plates, B, are rotated until they interleave themselves with the A plates, and occupy the position as shown in Fig. 9, the capacity of the condenser is increased to half its maximum capacity, as half the surface of the A plates is acting through the dielectric on to half the surface of the B plates; and finally if the B plates be still further rotated until they occupy positions entirely under the A plates as shown in Fig. 10, the capacity of the condenser is at its maximum. It is only necessary to fix to the moving plates a pointer, F, which can pass across the scale, G, and thus denote the exact position of the plates.

Our Prize Scheme

The articles which are at present appearing in THE WIRELESS WORLD in connection with our scheme of instruction in wireless telegraphy have aroused a great deal of interest among those who are qualified to sit in examination for the valuable prizes and certificates which the Marconi Company have generously offered to candidates who pass the approved test. Full particulars of the prize scheme were announced in our April and May issues, in the first of which we published letters from Lieut.-General Sir Robert Baden-Powell and Major-General Edward C. Bethune, cordially approving the scheme. The articles (of which the sixth appears in this issue) have been so framed that anyone having no previous knowledge of electricity will be able, if the articles are followed carefully each month, to understand fully the practical working of a portable wireless telegraph apparatus, in theory and practice, and with a little experience in working will be able to operate such a set successfully.

Those who have not yet applied themselves to the study of the series of articles which commenced in May last should apply immediately for back numbers of this magazine (May to September), and lose no further time in taking up the subject. The prize-winners will not only enrich themselves, but some of them will place the units or troops to which they belong in the enviable possession of a complete wireless telegraph station. Apart from the prizes and certificates, every student of our course must derive some personal advantage from the knowledge that he gains.

Methods of Signalling.

By "SCOUT."

Wireless takes its place amongst the various methods of signalling. All these have certain advantages, and their respective "pro's" and "con's." But as regards independence of weather conditions and light, wireless stands unique. If comparison is to be carried further, a telegraph line must be continuous; it is exposed to damage by weather or an enemy. In wireless two terminal stations only are required; science has employed ether as its connecting link.

Signalling should be divided into two classes—long-distance and short-distance signalling. The former would comprise wireless and line telegraph; the latter, heliograph, lamp, sound, and flag. Unfortunately neither of these can be relied on. Absence of sun reduces a possible 30 mile range with helio to no service. "Fog" puts the lamp out and darkness keeps the flag in its case. But the elements are not always against us, and, in the majority of cases we are masters of the situation. We Scouts are working our way through all methods, possibly a long way off "top dog," but time is on our side and keenness will pull us through.

With regard to wireless and line telegraph it is only a question of expense. Scout stations must, of necessity, be cheap ones, but the operator who can transmit 5 miles would be equally efficient at 500, if his station served. The mechanical work necessary for a wireless station has been often made by Scouts; possibly the only part bought would be the phones.

The conditions required for a Scout wireless station are briefly these: it should be a portable station and capable of transmitting at least 5 miles under all circumstances; the limit of distance is desirable on account of the cost of providing a station to work over long distances. Scouts should be very careful not to infringe the rules on which their licences have been granted and to follow closely the regulations for wireless operators. Their claims for consideration have been favourably considered by those in authority, and a special "call sign" has been allotted to them—"XBS." This call should always be used.

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GALENA FOR DETECTORS.

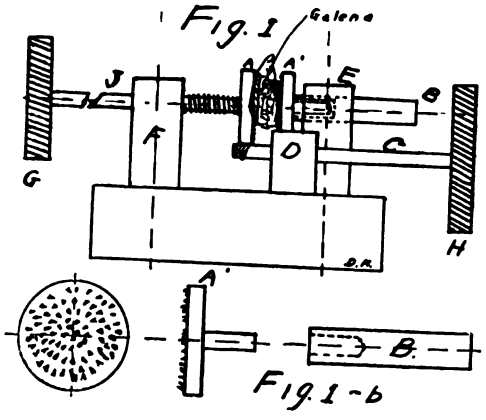
By D. B. McGOWN.

(The author has in use at his station a detector in which galena is used. As the practice is not a common one among amateurs, his experiences, described in the following article, should prove interesting.)

GALENA does not enjoy a very good reputation among the majority of wireless telegraphy experimenters, but if properly used it should give results as good as, if not better than, those obtained with any other form of crystal detector, or almost any type of receiving instrument.

It is not uncommon for experimenters to take a piece of galena and clamp it tight between two flat surfaces, or under a sharp point, and, as the signals are in consequence inaudible, to complain of the insensitiveness of their galena. Others run a heavy battery current through it, and, although this is not as bad as many forms of treatment to which the mineral is subjected, it is sufficient to prevent it giving the best results it is capable of. If experimenters would use and adjust galena properly, they would at once realise its value as a detector mineral.

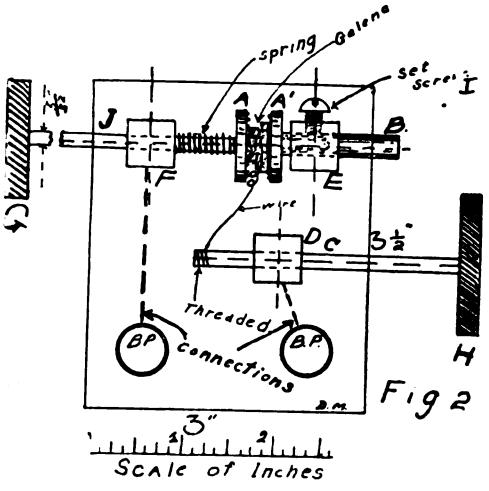
I have found that to get the best results from galena it is necessary to use a *light*



contact—the material of which this contact is made being of less importance than the lightness of the contact. For this purpose a short piece of 36 or 38 gauge copper wire should be fastened at one end, and the other allowed to rest by its own weight on the galena.

The contact points may be of various types, and a piece of graphite (not more than the point of a lead pencil) or a small piece of tungsten makes a sensitive combination. For local work a plain piece of copper wire is as good as anything; it is robust, and not easily affected by a transmitting spark.

The following is a description of a detector for galena which I have found to be efficient,



and the construction of which is shown in the accompanying diagrams.

In these diagrams F and E are threaded as shown, and screwed to the bottom of the base; the discs, A–A′, which are the clamps for the galena, are turned from ¾-in. brass rod. A is joined to rod, J, but A′, as shown in Fig. 1*b*, is left to turn freely, the short stem on A′ fitting into the hole threaded in B. Rod C is provided with a rubber knob, H, one end of which is threaded to give the contact wire a firm hold; the hole in D is bored sufficient to make the rod bind. The rod should not revolve too freely, nor should it fit too tightly; it should be just firm enough to turn easily by means of the knob, H. A spring is wound upon J so that A–A′ are forced together. The object of the set screw, I, in the upright, E, is simply to make B firm. The binding posts, B P, in Fig. 2, may be placed wherever convenient. The whole is then mounted either on a polished marble or a hard rubber base; the former may be recommended as it gives a substantial appearance to the instrument, and is cheaper than rubber, but if marble is used great care should be

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taken to obtain a slab which is free from all mineral veins, as these greatly reduce the insulating value of the marble. Should any trouble be experienced in fastening knobs G and H, a good method is to heat the rod, and then rub sealing-wax over it. The rod should be warm enough to make the sealing-wax liquid, and should then be forced into the knob.

Another method is to tap the hole in the knob and thread the knob to fit, it is then screwed on with sealing-wax. In this way no trouble will be experienced from knobs falling off. To adjust the instrument clamp a piece of galena between A and A', then bring the wire over until it touches the mineral. The crystal may be turned to and fro, and even clear around, and any spot may be touched by moving rod C. In this way a good spot may be discovered.

This detector may appear clumsy at first, but a little practice will soon show that it possesses many advantages, and that it is easy to adjust. It is important that the galena should be of good quality. If the portion available has been lying for any length of time in a space which is not air-tight, it should be broken, and a fresh surface obtained. The surface of the galena should never be touched with the hands or any portion of the skin, as enough natural oil will gather on the surface of the mineral to effectively insulate it against weak signals. If signals cannot be heard through the first piece of galena tried, the mineral should be broken up until either a sensitive piece is obtained or until it is too small for use. The best galena will have a "wavy" appearance. It is almost impossible to describe a good piece of galena, but experimenters should have no difficulty in picking this out for themselves.

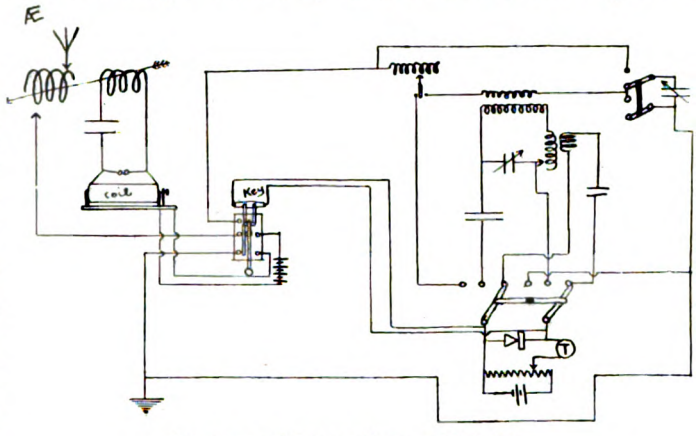


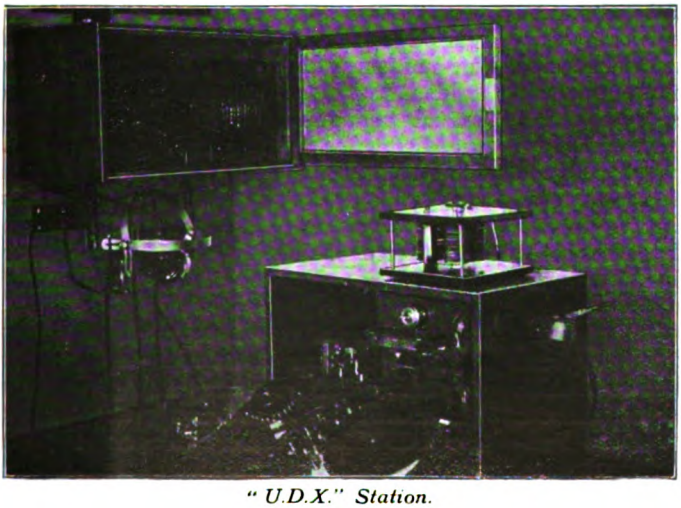
Diagram of Connections, "U.D.X."

AN AMATEUR'S STATION.

By "U.D.X."

The accompanying illustrations of my wireless station might interest amateurs.

I am using storage battery power of 8 volt, a 2-inch home-made coil taking $2\frac{1}{2}$ amps., and fitted with a hammer break, which I have found is best for small coils. I am able to send 20 to 25 miles, my wave-length being 450 metres. The high-tension condenser has a capacity of ·0062 m.f.'s, composed of copper foil and half-plate photographic plates. The sending jigger primary is $\frac{1}{4}$ copper tubing, and the secondary $\frac{7}{18}$ lighting cable. The sparkgap is



"U.D.X." Station.

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of mild steel. I get a fine musical note.

My receiving apparatus is composed of 3 circuits—plain open circuit for picking signals quickly, and by a switch I can change over to jigger, and to get still finer tuning I have an aperiodic circuit. I also have a portable receiving set made on the same lines, but not shown in the photo-graphs.

The aerial consists of four wires of 16 s.w.g. bare copper separated 2 feet apart. The mast at the free end is 65 feet high, and that at the receiving end 40 feet; the distance between the two being 240 feet, and the total length of the aerial 279 feet. My earth is composed of ordinary wire netting buried about the garden 1 foot deep.

The oak box containing the receiving apparatus is made to close up when not in use; one of my variable condensers is placed on the lid, which is pivoted, and has spring contacts for the condenser.

AMATEUR NOTES.

OUR remarks in a recent issue concerning the charge of one guinea which the Postmaster-General has decided to make when granting amateur licences has brought a protest from an esteemed correspondent who signs himself "Wireworm." It is not the fee itself to which our correspondent objects, it is the decision to apply it to amateur stations which exist only for "receiving."

What he overlooks, however, is that to permit the erection of this class of station without any control or inspection would be to provide a loophole for abuse, which would in the end result in much more stringent regulations. We think that he rather exaggerates the freedom which the average "Britisher" enjoys "of doing what he likes in his own house," and we fail to see that the proposed charge will result in any further infraction upon the rights and liberties of the "Britisher" on his own hearth. At the same time "Wireworm" points out the difficulty of enforcing the regulations regarding licences in the case of users of receiving sets, and he instances a hypothetical case which we hope he will not endeavour to fulfil with a view of testing the ability of the Postmaster-General to enforce the regulations. He states:

"We have heard lately of bedsteads and gas pipes being successfully used as substitutes for receiving aerials. Suppose I go a little bit further and discover that I get Paris, using only domestic appliances (such as a bedstead on an upper floor as an aerial, the wires of a piano suitably connected as a tuning coil, a nest of cake tins with buttered paper between them as a condenser, a piece of washing soda and a darning needle as a detector, and my tongue in place of the 'phones), must I obtain a licence from the Postmaster-General before I dare use such apparatus to get the time from E. L.? A few more discoveries (!) in 'wireless' and we shall require to get a licence from the Postmaster-General before we furnish a house, and we shall have inspectors inspecting our pots and pans to see that they conform to the wireless regulations!"

* * *

The United States of America claims to be the birthplace of the Amateur Wireless Club. At all events the movement has fostered very considerably in the United States, and there is in existence a large number of clubs, all of them carrying on very useful and very instructive work. One of these clubs, the Radio Club of Manhattan, has intimated its wish to exchange suggestions with amateur wireless societies in Great Britain and we feel sure that the interchange of ideas between the clubs of the respective countries will be mutually beneficial. The Manhattan Club was formed for the purpose of bringing together amateurs residing in the city of New York and coaching those who wished to pass the Government examination for amateur radio licences. Only those who hold a first grade amateur licence or who intend taking the qualifying examination are eligible for membership. No member is admitted under the age of 18, and one of the qualifying conditions is ability to transmit and receive in Continental Morse Code at a speed of not less than 15 words per minute.

* * *

A meeting of the Liverpool and District Amateur Wireless Association was held on September 11th, the chair being taken by Mr. J. Jardine. Several new members were enrolled. The question under consideration was the matter of "Receiving Outfits," and Mr. Jardine gave a description of his receiv-

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ing set, by means of which he is able to obtain good results, and to a great extent obviate local jambing. Mr. Frith exhibited a small model receiving outfit, contained in a case $8\frac{3}{4}$ inches by $1\frac{3}{4}$ inches by $5\frac{1}{4}$ inches, and holding inductance, silicon detector, blocking condenser, and a double pair of headgear 'phones, 3,000 ohms; a very compact outfit, suitable for field work. Mr. J. T. Thompson, J.P., Mayor of Birkenhead, has consented to become a Vice-President of the Association.

* * *

A number of experimenters in wireless telegraphy living in Barnsley district met recently for the purpose of forming a local wireless association. As a result of this gathering the Barnsley Amateur Wireless Association came into existence, with Mr. C. H. Matthews as Chairman and Mr. C. Pickering as Hon. Sec.

* * *

A general meeting of the Dublin Wireless Club was held recently. Dr. Spencer Sheill occupied the chair. Mr. Britton gave an account of the committee's visit to the proposed new premises of the club, placed at its disposal by the treasurer, Mr. Lewis. It was decided that two 35 to 40 ft. poles should be used, and Mr. Britton offered to supply the manual labour and to superintend the erection of the same. Messrs. Carter, Draper and Campbell each contributed £1 towards the cost of the aerials, etc. Three new members were elected.

* * *

A meeting of the Northampton and District Wireless Club was held recently, when about 30 amateurs were present. The Postmaster-General's charge of one guinea was discussed, and in this connection several letters from other clubs were read. Mr. H. B. Lees-Smith, Mr. F. C. McCurdy, and Mr. H. Mansfield (the M.P.'s for the district), have promised to mention the matter in the House of Commons.

* * *

The first licence for a wireless telegraph station in the Taunton district has been granted by the Postmaster-General for St. Andrew's Drill Hall, Rowbarton, Taunton, used by the parochial company of the Church Lads' Brigade. The wireless station is situate in the reading room of the drill hall, where the apparatus for receiving the waves is fixed. The apparatus has been made entirely by the Rev. Francis M. Trefusis, curate of St. Andrew's and assistant chaplain of the Church Lads' Brigade Company, who is a son of the Bishop of Crediton. The aerial is over 80 ft. from the ground. The instruments have been working satisfactorily, and the first public demonstration was given at the Church Lads' Brigade fete and gala on September 4th. The station will be used continuously during the coming winter for teaching members of the Church Lads' Brigade Company wireless telegraphy.

* * *

The first case of violation under the Federal wireless law was brought before the Federal District Court, New York, July 7th. Elman B. Myers, the defendant, is charged with operating, without a Federal licence, a wireless apparatus of sufficient power to carry on radio communication beyond the borders of New York State. The case will be tried before a jury.

* * *

Amateur wireless telegraphy has developed to such an extent that a directory of wireless stations has now been published by Messrs. A. W. Gamage, Ltd., for private circulation only. The list contains the names of some 500 stations—only a portion of the total number licensed. However, the list is very interesting, and it should be useful to beginners by enabling them to get into touch with other enthusiasts.

* * *

A meeting was held recently in Edinburgh by a number of students who are interested in wireless telegraphy. About fifty attended, and decided to form themselves into a club called "The Edinburgh Wireless Club." Office-bearers were elected as follows: Mr. William D. Owen, president, and Mr. A. Ellis vice-president. Committee: Messrs. J. G. Aitken, W. S. Cruikshank, A. P. Kelly, J. Easson, J. D. Fergusson, and A. C. Heaven. Secretary, Mr. G. S. Creighton, 25 Rankeillor Street

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

A. M. B. (Hunstanton).—Take your aerial at an angle to keep it away from wall of neighbouring building. Could you not go on opposite side of your house? High buildings close to aerial are bad for screening.

J. T. L. (Northampton) proposes erecting a receiving station, and asks for instructions.—*Answer.*—You can use two parallel wires separated by 5 feet spreaders, each wire being No. 18 copper (telephone wire) bare. Read our Instructional Articles. Range depends on surroundings, on apparatus, and on your own skill and knowledge.

SIGNAL (Treharris) asks for information as to the source of some signals which he receives regularly at certain times, which he gives, and with certain characteristics, which he also gives. It is contrary to our custom to answer such queries as this; in this particular case the station is so well known that he need only ask some other amateur.

A. W. (Glasgow).—The impedance presented by a circuit containing resistance, R, capacity, C, and inductance, L, to a frequency, n, is $\sqrt{R+^2(Lp-\frac{1}{Cp})^2}$ where p denotes 2π. If the quantity inside the bracket is equal to zero, the impedance becomes simply the ordinary resistance: this is the condition for resonance, used in wireless circuits. And if $Lp-\frac{1}{Cp}$ equals zero, it follows that $n=\frac{1}{2\pi\sqrt{CL}}$ and 2π equals 2×3.14. Hence the value given.

R. F. D.—Since the wave-length depends on inductance and capacity in the transmitting circuit, how is it that one can obtain a variation in the note of the spark without varying the wave-length?—*Answer.*—You are mixing up wave-frequency (governing the wave-length) with wave-train frequency (group-frequency) which determines the *note*. The two things are quite separate, and can be varied independently. Read our instructional articles, and study carefully reply to B.R.L. in the May number, and to "Brum" in August number.

M. S. (London).—The thickness of aerial wires has little importance for small-power transmitting and for receiving. On the other hand, we do not like your idea of letting up a kite with twine which has a thin wire twisted round it. The difficulties you will experience when you come to wind up the two together will be serious. We advise you either to use a fairly thick wire as kite-wire and aerial combined, or—if you have an assistant—to use twine for the kite-line and suspend a thinnish aerial wire from a suitable point on that twine. This plan has the advantage that the kite can rise to quieter levels of air than it could do if it had to carry the aerial all the way with it.

F. D. M.—(1) Is it possible to work a Morse writer in conjunction with a crystal detector; if so, how is it done? (2) Is it better to lead in from the lower end of the aerial, supposing one end to be higher than the other.

Answer.—(1) The average signal met with in ordinary wireless gives, when rectified by a crystal detector, something a good deal less than a microampere. To utilise such a very small current to work a Morse inker requires a very special relay, and though we have seen a home-made relay which would work on half a microampere, such a piece of apparatus is not as a rule within the scope of an amateur. Several highly sensitive relays, of various ingenious principles, have recently appeared on the market; but these are somewhat costly and require expert treatment, and even they are more suited to a siphon-recorder than to a Morse inker. With large receiving aerial and strong signals, a much larger current may be obtained, and a less sensitive relay made to operate an inker. There is scope for much experiment in this direction. (2) Depends on the position of the receiving room with reference to the two ends; the down-lead should not be taken back too much *under* the horizontal part of the aerial. Try for yourself.

W. A. M. asks: (1) For telephones with a total resistance of 100 ohms, would an induction coil of 1 ohm primary and 100 ohms secondary resistance work as a "step-down" transformer with a crystal detector? (2) What would be the best crystal to use for the lowest resistance; and (3) would it be possible to send about 200 yards with a shocking coil with the contact-pillar connected to a good earth, and no aerial?

Answer.—(1) We doubt if much improvement will be found by the use of a transformer with so low a secondary resistance as 100 ohms in the place of the directly-connected telephones. A small ignition coil—such as is used for many motor-cars or motor-cycles—would be much better, even if not in good enough condition for its original purpose.

(2) We do not care to recommend any crystal except the carborundum crystal. Some carborundum crystals can be found which have no resistance. One of the lowest-resistance crystal combinations is the Galena-Graphite couple; you might experiment with that.

(3) You would be getting back to pre-Marconi days. In point of fact, a 10-inch spark-coil has actually been used in this way to communicate over two miles. But if you have an objection to the ordinary aerial jutting up into the air, why not try the Marconi directional aerial in the particular form where it is lying on the ground?

F. Y. L. (Newbury).—(1) Is there any method of adapting a receiving set consisting of an inductance, crystal detector, condenser, and 'phones to take down fast messages automatically? (2) Is there any danger from lightning in having my aerial stretched over my house. My earth runs down the side of the house to the spout of a pump (indoors), and branches off to a plate consisting of a cycle gear-wheel buried 4 feet down. Of course, I have switches to cut out my instruments. (3) Why can I hear certain stations when my aerial lead is disconnected from my instruments, but my earth still connected? (4) The best exam. or exams. to take in electrical engineering

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and the best way to prepare for them.—*Answers.*—(1) Hardly within the scope of amateurs, unless the signals are very exceptionally strong. (2) The gear-wheel has its points, but as an earth is hardly satisfactory. Bury some galvanised-iron sheeting. Do not trust to your piping if you want to be really safe, but take a wire direct to the sheeting. Keep your aerial always earthed, breaking it by a one-hundredth inch gap when you are receiving, then violent atmospheric discharges will pass to earth through the gap instead of through your receiving apparatus. (3) A certain amount of the energy from a transmitting station is in the form of earth-waves, and if such a station is near at hand these waves may be detected. Also, your receiving gear appears to be in an upper story, so that your earth-lead acts in the way of an aerial to intercept the æther waves. (4) Enter for a course at one of the London technical colleges affiliated to London University. You might prepare for their entrance examinations by one of the "Correspondence" courses.

W. A. A. (Hull) has an induction coil of the non-trembler type, and wants to know whether he could get a continuous spark if he used a small 3-phase alternator; and, if so, what voltage he should use, and whether any part of the primary circuit would have to be shunted by a condenser. If he *must* employ a 3-phase alternator, let him leave two phases alone (open-circuited) and utilise the remaining one. No condenser necessary. The voltage might be 12 at a maximum, and to start with it should be reduced very much by a variable resistance in the field, and gradually increased till the best spark is produced. The coil should be protected by fuses suitably proportioned to the carrying capacity of the winding. No definite information can be given with so little data.

BRUM.—Referring to our reply under this heading in the August number, this correspondent asks for information on the following point: We state that the uni-directional impulses charge up the condenser which discharges through the telephone; why should there be no discharge until each separate train is completed? Is it that the high-frequency of the rectified oscillations is such as to make each train into virtually a small amount of *continuous* D.C. ?—*Answer.*—Yes. We do not mean that the condenser waits for the completion of each train before commencing to discharge; it merely acts as a reservoir into which the rectified impulses flow and accumulate, and out of which there is a path—the telephone coil—by which they can overflow in a steady stream, although it forms no path for them (owing to its impedance) while they are in the form of high-frequency pulses.

L. J. W. (Ashbourne) is replanning his aerial, and asks advice as to lengthening it by increasing the distance between poles. His horizontal part is 65 feet high and 123 feet long, and at present his lead-in comes from the nearer end, thus forming an inverted L aerial (twin). He asks which would be best, that or a T; and he wants it for receiving from long-distance stations, and also for transmitting on 300 metre wave. If he increases to a 200 feet L, he will probably find it too long for his 300 metre wave, and will have to put a condenser in series. On the other hand the extra length will mean less tuning inductance for receiving long waves, and will give better signals. A T of the same total length would give him a very good aerial for transmitting his 300 metre wave, but would need more inductance for receiving long waves. If he slings a second aerial for transmitting only, he will have to insulate his long aerial during sending.

G. W. H. (Constantinople) noticing our remarks about using a long jigger-secondary, coupled at its lower end to the jigger-primary, for high-resistance detectors, proposes to extend his secondary (thus using a smaller tuning-capacity across it) by winding it in more than one layer. We advise him on no account to do this: apart from the serious question of capacity from layer to layer, this plan does away with one of the objects of a long secondary—the keeping away of the high-potential end from the earth-connected circuits. In the distant land where he lives, he has only with great difficulty obtained a suitable ebonite former for his secondary; so that to extend his windings in a single layer, he had better dispense with ebonite and use a cardboard tube, or a wooden cylinder, winding on it several layers of paraffined or shellaced paper to provide good insulation. He also asks for a list showing the order of magnitude of the resistances of the various crystal receivers in common use. We advise him to adhere to the carborundum with battery and potentiometer—either a high or a low-resistance carborundum to suit his taste—but for his satisfaction we give the following list, in descending order of resistances: high-resistance carborundum, silicon, bornite-zincite, copper pyrites-zincite, tellurium-zincite, galena-graphite. Low-resistance carborundum may come anywhere between high-resistance carborundum and bornite-zincite.

J. L. M.—*Twelve-mile Range.*—I wish to communicate 12 miles away. Can I do so with this apparatus? Aerial: Umbrella type, 60 feet long by 18 feet high. It has two wires "straight away," and is mounted on the top of a house 35 feet high. Receiver: One 70 ohm. 'phone, and a silicon-gold detector. Transmitter: ½-inch spark coil, and a Leyden jar condenser with ·0001 microfarad capacity. Would it be better to use a condenser with a capacity of ·00034 microfarad? What gauge of wire should I use (1) for the transmitting helix; (2) for the tuning coil; and (3) for the aerial? How much would I need for Nos. (1) and (2)?

Answer.—Your aerial seems all right; possibly rather low, especially if there are water-tanks or other earthed masses of metal in the roof of the house. Good insulation is most important, particularly for transmitting. Your receiver is connected quite wrongly: you cannot hope to get good signals when you put a high resistance, such as a crystal, in series with your aerial-earth circuit. If you do not wish to go to the trouble of making the best arrangement—a proper receiving jigger with separate windings, designed for the particular crystal in use—you might try a tuning-coil with two sliders, used as an auto-jigger in conjunction with a variable condenser (small) as shown. With regard to your transmitter, your connections give what is practically the old, crude "plain-aerial" arrangement. The condenser, used as you show it, has no effect on the tuning, but merely alters the character of the spark; its value is best found by experiment, but it is not likely to be more than half a standard "jar." What kind of jar have you, to give you a value of only ·0001 microfarad? If you want to be less prehistoric than "plain aerial," make up a proper transmitting jigger. It is impossible to give the capacity which you will require. Use as large a one as possible without reducing your spark below, say, 1 m/m. Tune this with the primary of your jigger to the wave-length specified in your licence. This should not be more than twice the natural wave-length of your aerial—which should be one of the first things for you to ascertain. Tune up the aerial, with the jigger-secondary, and, if necessary, with external tuning-inductance, to the same wave. Use a wave-meter. 3/22 insulated cable will do well for the windings of the jigger, which might be wound on formers about 5 inches square, with some arrangement by which you can vary the distance between the coils, and so the coupling. It is impossible to give actual quantities of wire, as this depends on the capacity of your primary condenser, on your aerial, and on your wave-length. You must find out for yourself by experiment. You could wind your receiving tuning-inductance with No. 26 s.w.g. wire.

H. C. B. (Norwich).—(1) Is it possible to calculate the capacity of an aerial when its size and shape are known? (2) What is the formula for finding the antenna energy in

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watts? (3) What is the connection between the antenna energy and the range of the station? (4) Is it necessary to have a licence in order to use a receiving apparatus only?—*Answers.*—(1) Only in the simplest cases, with any degree of accuracy. See Dr. Fleming's "Principles," Chapters II. IV. and VIII., etc. (2) See reply under heading "Radiation Resistance" in *Marconigraph* (January, 1913, page 455). Pedersen's modification of Lodge's formula gives for the radiated energy the following expression: 0·4 × (effective amps. in earth-lead)² × $\frac{l^2}{\lambda^2}$ kilowatts where λ is the wave-length and l is the effective height of the aerial. The term "effective height" is defined by Lodge thus: "If the earth were a perfect conductor, the effective height would be twice the apparent height." (3) A very controversial point, and one which cannot be discussed in these columns. There are, besides, very many considerations to be taken into account, such as the nature of the intervening land, etc. (4) Yes. Apply to the Postmaster-General for application forms. There will be a charge of one guinea.

R. L. S. R. (London).—I have a vertical single-wire aerial 40 feet long; if its natural wave-length is four times its length, it will be 160 feet—*i.e.*, nearly 49 metres. If I now calculate the inductance and capacity of the aerial from the formulæ for these quantities at high frequencies, and then calculate from these values (using $\lambda_{cms}=2\pi\sqrt{L_{cms}\times C_{cms}}$), I get $\lambda=78$ metres, which is considerably greater than the value given above. Also, in the latter case, λ will vary with the diameter of the wire, although only slightly perhaps. —*Answer.*—The formula you give for capacity $\left(C_{cms}=\frac{l}{4\cdot6052\log_{10}\frac{2l}{d}}\right)$ is correct, but you give for inductance

$$L_{cms}=2l\left(\log_{10}\frac{4l}{d}\right)\times 2\cdot3026$$

which is quite wrong; it should be

$$L_{cms}=2l\left(2\cdot3026\log_{10}\frac{4l}{d}-1\right).$$

The value C is the *actual* capacity; to obtain the *equivalent* capacity (which is what you want) you must multiply this by $2/\pi$—*i.e.*, by ·637. Then substituting in the formula for the wave-length, you will obtain a value about 60 metres. This gives you a factor of about 4·9 by which to multiply the length of your aerial, and this factor, as a matter of fact, is the one to be used in all calculations involving the above formula. This is very nearly the factor given by Prof. Macdonald in his mathematical investigation. In actual practice, the value varies from 4 (in the case of a single long *very thin* wire) to 5 or over.

W. S. (Paisley) is dissatisfied with his results when he reads of the records obtained by other amateurs—such as Paris with the 'phones 40 feet away, ships 1,000 miles away, and so on. The average height of the horizontal portion of his aerial is only 47 feet without allowing for sag, and he gets Paris (at night with the 'phones 1 foot from ears), Norddeich, Cleethorpes, Liverpool (night and day), Poldhu, Scheveningen and a few others, not yet identified at night.

We do not think this is a record to be ashamed of; as for the rival results which make him envious, we do not wish to discredit them in any way, but we would remind W. S. that "freak" nights are by no means uncommon, and their results startling. He asks for any suggestions how he could improve matters in his case. One weak spot is the lowness of one end of his T aerial—only 27 feet—compared with 67 feet at the other end. If possible, he should increase this 27 feet, and thus add to the average height. Moreover, since he is anxious to receive long waves, he might convert his aerial from a T to an inverted L, thus decreasing the additional inductance required for tuning. He tunes his aerial-earth circuit to the long waves by a parallel condenser; this is not always an efficient way, and he might dispense with that condenser and have additional tuning inductance. Tuning on the secondary he finds not at all sharp; his secondary is 22 d.c.c. wound for a length of 5 inches on 12 inches diameter drum, and his tuning condenser has maximum value ·0005 mfd.

With such a short, wide secondary it is impossible to get the "free high-potential end" which we have so often advocated. W. S. might try a much longer secondary with smaller diameter, such as would just enter his primary, which would thus be coupled only to the low-potential end, leaving the other end well apart from the earthed primary. The crystal would be connected to the high-potential end, then through the telephones to the low-potential end—*i.e.*, the end coupled to the primary. Using the same condenser and the same size of wire, the secondary would have to be about 12 inches long if a 7-inch former were used. The coupling could be varied by raising or lowering the secondary in the primary

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R. J. H. B. (London).—(1) Your aerial is fairly good, the weak point being nearness to walls and roof. The free ends should *not* be joined together as you show them. If you could extend each wire horizontally along roof at right angles to plane of paper, you would increase the wave-length and thus decrease the additional inductance required for tuning to the long waves; this would improve matters. (2) Water-drain will be a fairly good earth for receiving and not bad for transmitting on small powers, if it goes well underground. But are you sure that it is not earthenware below ground? Nearly always a continuous wire lead is advisable in preference to pipes; these often have various joints and jointing-material to break their continuity. We deprecate the use of gas-pipes for transmitting-earth because a spark might easily explode any gas which might be leaking and accumulating below floors, etc. (3) 1,000 ohms is quite reasonable, though not so high as might be desired. (4) The ii's are divisions between 3-letter code signals. We do not see how those signals can "sound like a weather report" if every three letters are punctuated by ii. (5) and (6) We never reply to questions of this kind. (7) Considering your environment, you would probably require a 2-inch coil.

S. H. D. (Westcliff).—In your answer this month to the inquiry of your correspondent S. S., you say it is quite possible to record the Eiffel Tower messages with a Morse Inker by means of a coherer and relay. Is this answer applicable to my installation? I have a Horophone fixed in connection with an aerial 60 feet high consisting of four strands of copper wire in parallel, each about 40 feet long.

The Paris signals are fairly distinct in the telephone, but as the instrument is fixed in my shop the entrance and exit of customers often interrupt the signals.

Answer.—If your crystal (in your present apparatus) is a good one and properly adjusted, and your circuit is in tune, and yet the Paris signals are only "fairly distinct," you would probably have some difficulty in getting a coherer and Morse Inker to work well. A good crystal receiver is much more sensitive than a coherer. Could you not put your receiver in a back room where customers would not be entering? Unless you can improve your aerial, or your "tuning," so that a good crystal will give you really loud signals, it is not advisable to try a coherer. If you can so improve your apparatus—as a last resource you might heighten your aerial (and make sure that each wire is really of the same length and not only "about")—as to give really loud signals, then you might try a coherer, which you could obtain from any dealer in "amateur wireless apparatus." You had better "read up" coherer-receivers in some elementary book. We fear your "horophone" circuits are not well adapted to a coherer. Cleethorpes sends practically all day and all night, at half-hour intervals. Poldhu at 11.30 at night.

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THE "WIRELESS WORLD" PURCHASE BUREAU

THE difficulty of obtaining personal supplies has often been a serious disadvantage to wireless telegraph engineers, operators, and others, whose calling takes them away for lengthy periods to remote quarters of the globe. Clothing, footwear, books, scientific instruments, and other articles which help to lighten the monotony of an often desolate country, are not easily obtainable unless the prospective purchaser has a trading account with a number of tradesmen in this country. Even if this is the case, there remains another difficulty which is not easily surmounted, for tradesmen are generally unwilling to accept coinage of many of those countries to which wireless engineers are sent. A case which came to our notice recently illustrates this difficulty.

An engineer who was sent to one of the South American States had occasion to order a pair of special boots, which were necessary on account of the rainy season then approaching. He was unable to obtain English money and was hundreds of miles away from the office of the British Consul. The only course open to him was to send local money with his order. He had despatched his order so that the boots should reach him in time for the rainy season, but instead of the boots there came a very polite letter from the firm regretting their inability to accept the notes which he had enclosed with his order.

This difficulty is typical of many which have been brought to our notice, and we have therefore evolved a scheme which should be a great convenience for a large portion of our readers. All that is necessary for a Marconi engineer or operator to do when ordering supplies, is simply to write to us, giving particulars of his requirements, together with an order for the purchase money upon the company who will deduct the amount from his salary cheque.

At the same time he should write to the Marconi company, mentioning that he has given us authority to make such purchase and intimating that the cost of such purchases is to be deducted from his salary. The receipt of the suppliers of the goods will be understood to be a full and sufficient discharge of his salary to that amount.

Anyone desiring to make use of our services should notify and give us authority to act for him before he goes abroad.

Again, if he has made arrangements for his salary to be paid into a bank or to someone nominated to receive it while he is away, he should notify to his nominee that he has authorised the company to deduct from his cheque the amount of payment for purchases made on his behalf through us. In every case the goods will be purchased at the best possible price, and will be sent carefully packed at cost price, plus postage or cartage.

Wireless telegraphy has been established in the Bahamas. The radio-telegraphic station, which is situated at Fort Charlotte, Nassau, has been formally inaugurated by his Excellency Sir G. B. Haddon-Smith, the Governor, the first message being one sent to the King.

* * *

Regulations have recently been issued regarding the installation of wireless apparatus on steamers registered in New Zealand and authorised to carry not less than 50 passengers, or engaged in foreign or intercolonial trade. They provide for the employment of skilled operators, and the apparatus must be capable of transmitting and receiving messages over a distance of at least 100 miles at any time of the day.

Since the last announcement in THE WIRELESS WORLD the Marconi Philatelic Society has held several meetings, all of which have been extremely satisfactory, both as regards attendance and the interest displayed. Holidays prevented a meeting being held in August, but now that the general routine has been resumed it is hoped that a good many of the members will be present at the next meeting, which takes place on October 7th.

As is generally known, the meetings are held for the purpose of discussing matters of interest to stamp collectors—such as new issues, etc.—and for the examination and exchange of duplicate stamps. They are due to take place on the first and third Fridays in each month, commencing with the next meeting in October. One very pleasing feature of the Society's membership is the enrolment of several wireless operators; but the Secretary is anxious to get into touch with the members of the Engineering and Operating staffs, whose work affords them such splendid facilities both for increasing their own collection and for helping the interests of the Society.

Any stamps sent for exchange purposes should be forwarded to the Secretary, Mr. W. J. Everett, at Marconi House, and should reach him not later than the day before the meeting.

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Patent Record.

The following patents have been applied for since we closed for press with the September number of this magazine :

No. 18,326. August 12th. Marconi's Wireless Telegraph Co. and H. J. Round. Wireless telegraph receivers.

No. 18,502. August 14th. G. Marconi and W. S. Entwistle. Transformers for high frequency currents.

No. 18,939. August 20th. Ludwig Mach. Apparatus for detecting heat radiations.

No. 18,961. August 21st. A. B. Williams and Wm. Alex. Solomon. Electro-magnetic relays for use in connection with W. T. installations and for other purposes.

No. 18,962. August 21st. A. B. Williams and Wm. Alex. Solomon. Spark gaps for use in connection with W. T. installation.

No. 19,855. September 2nd. Guilio C. L. V. Ulivi. Apparatus for projecting electro-magnetic rays to a distance.

No. 19,911. September 3rd. Percy G. Webb and Joseph Krammer. Apparatus for wireless telephony.

No. 19,966. September 4th. Wm. P. Thompson (for Soc. Anon. des Télégraphes Edouard Belin). Method of and apparatus for the transmission of messages and designs such as photographs, cliches, and the like.

No. 20,097. September 5th. Guilio C. L. V. Ulivi. Apparatus for projecting electro-magnetic rays to a distance.

Marconi Athletic Club.

The cricket season has drawn to a close. On the whole the weather has been favourable, and most of the Saturday matches have been played on good hard wickets.

During the season, 17 matches were played, with the following results : Won, 3 ; Lost, 13 ; Drawn, 1.

The cricket throughout the season was very enjoyable. Many of the matches were keenly contested and resulted in a close finish. The poor percentage of wins is undoubtedly due to the fact that so many changes were made in the team week by week, so that the club was unable to get together a winning combination. Below is the record of the most successful batsmen :

	Innings	Runs	Times not out	Highest Innings	Average
Wheeler, S. H.	8	111	1	42	15·86
Menear, J. F.	10	137	1	27*	15·22
Wagstaff, E. J.	12	177	–	56	14·75
Delange,	6	58	1	29*	11·60
Williams, R.	9	91	–	35	10·11

* Signifies not out.

The most successful bowler was Mr. E. J. Wagstaff, with 47 wickets for 314 runs (average 6·68). Mr. S. B. Balcombe was next in order of merit with the bowling, 37 wickets for 469 runs (average 12·67) ; Mr. F. W. Bates was third, with 21 wickets for 289 runs (average 13·76).

The club was well served by Mr. R. Williams's excellent wicket-keeping.

The return match—London Office *v.* Chelmsford Works—was played at Chelmsford on Saturday, September 6th, and a very enjoyable game resulted in a win for the Works team by 26 runs.

Messrs. Eales, 34, and Warner, 29, carried off the batting honours for the Works team, and Mr. Eales also proved himself the most destructive bowler, securing 7 wickets.

The most successful batsmen for the Office team were Messrs. Williams, 13 ; Bates, 13 ; Menear, 12 ; Wheeler, 11 ; whilst Messrs. Bates and Balcombe were the most successful bowlers.

* * *

The football season opened on September 20th with a match between the club team and the Marconi House School. October 4th should be a great day in the season's events, for then the club plays Dartmouth Athletic Club, in the competition for the London Junior Cup. On the 11th instant a league match has been arranged with Winchester Athletic Club, and on the 18th with Aster Football Club. Last year the Marconi Club had a very successful season, and it is to be hoped that they will not only keep up their reputation, but add thereto, and for this the hearty co-operation is required of all the members of Marconi House, not only as players, but as supporters. Both the captain and vice-captain, Mr. J. F. Menear and Mr. F. B. Lord, have resigned, and it will be necessary to call a general meeting to elect their successors.

* * *

The tennis courts have been well occupied during the latter part of the summer. The handsome Challenge Cup presented by Mr. D. Willock, of the Electric Construction Co., for singles competition, on the all against all principle, has proved a great incentive to singles play, and has provoked many keen contests. The competition has only recently concluded, and the result has not yet been announced.

The tennis match against the Chelmsford Works team on Saturday, August 30th, was an event of great interest to our tennis section. Three doubles and four singles were played, the home team being fortunate enough to gain the victory in each event.

* * *

In spite of the fact that during the last few months outdoor interests have been in the ascendant, the Musical Society has kept the even tenour of its way in a most laudable manner. Every Tuesday evening has been devoted to musical practice, and its effect is already discernible in the increased confidence and unity of the orchestra. At present there are twenty available members, but double-bass, trombone and flute players are much wanted. Will any member of Marconi House come forward to fill up the deficiency ? He will be made greatly welcome by the secretary and members of the Musical Society.

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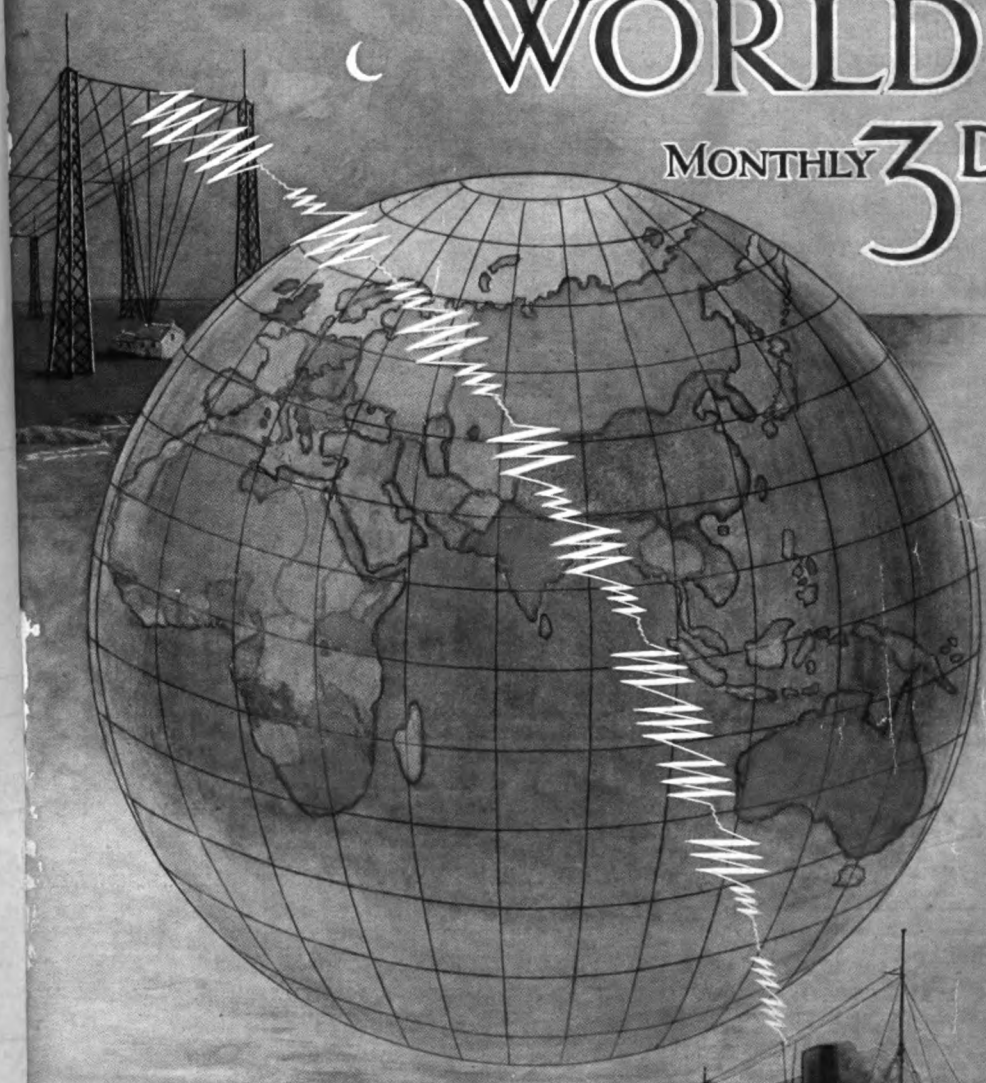

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The Editor will be pleased to receive contributions; and illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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The Magic of Wireless

"It seems to me beyond question that the name of Marconi will be associated for ages to come with one of the greatest conquests of the human spirit—a conquest whose full significance we can as yet, perhaps, but dimly perceive."—MR. WILLIAM ARCHER in "THE DAILY NEWS AND LEADER."

THE past month, which has furnished a terrible reminder how fire, the most powerful of the friends of man, may become his most terrible enemy, suddenly arising amid the quietude of earth or water to overwhelm him, has left an ineffaceable record of man's power to control the blind rebellion of the elements through the means which Mr. Marconi has placed at his disposal. In the burning of the *Volturno* in mid-Atlantic, and the rescue of 521 souls, we have an impressive example of the beneficent effects of wireless telegraphy which, had it been foretold fifty years ago, would have been regarded as incredible. The thought of ten great ships converging on the scene of the disaster, summoned thereto by the "S.O.S." appeal sent quivering through the storm over hundreds of miles of sea, raises a thrill of gratitude to the great man whose genius has made such a thing possible. For there can be no doubt that but for wireless telegraphy every one of the 657 lives on board the *Volturno* would have been lost. Indeed, the death roll would have been greatly reduced if the people had put more faith in the saving efficacy of the Marconi apparatus, and had not plunged panic-stricken to their doom.

The salvation of the greater part of the *Volturno* passengers and crew, it is observable, was due to the fortunate chance that one of the ten vessels within the Marconi call happened to be carrying an oil-tank. The *Narragansett*, which is the vessel referred to, belongs to a class of steamship among which the installation of wireless telegraphy is just beginning to make considerable headway, and the assistance which she was able to offer on this occasion proves the value of wireless telegraphy, not only for passenger vessels, but for freight vessels of all kinds.

The amount of traffic passing between the *Volturno* (working after the failure of the electric current entirely upon her emergency gear) and the rescuing ships, and between these ships and the shore stations, bespeaks volumes of praise for the reliability of the wireless apparatus under most trying circumstances. There was no failure, no confusion, no interference; in all cases the stations worked splendidly, and fully merited the concluding words of Mr. Arthur Spurgeon's first wireless message from the *Carmania*, briefly announcing the facts, which were: "Triumph Marconi."

It is indeed a marvellous object-lesson to the world in the beneficent power of wireless. What would have been a disaster without a gleam of brightness in the dreadful story, has been miraculously mitigated by the rescue of the 500 odd lives. The story impresses once again upon the world that the perils of sea travel have had more than half their terrors destroyed by wireless telegraphy.

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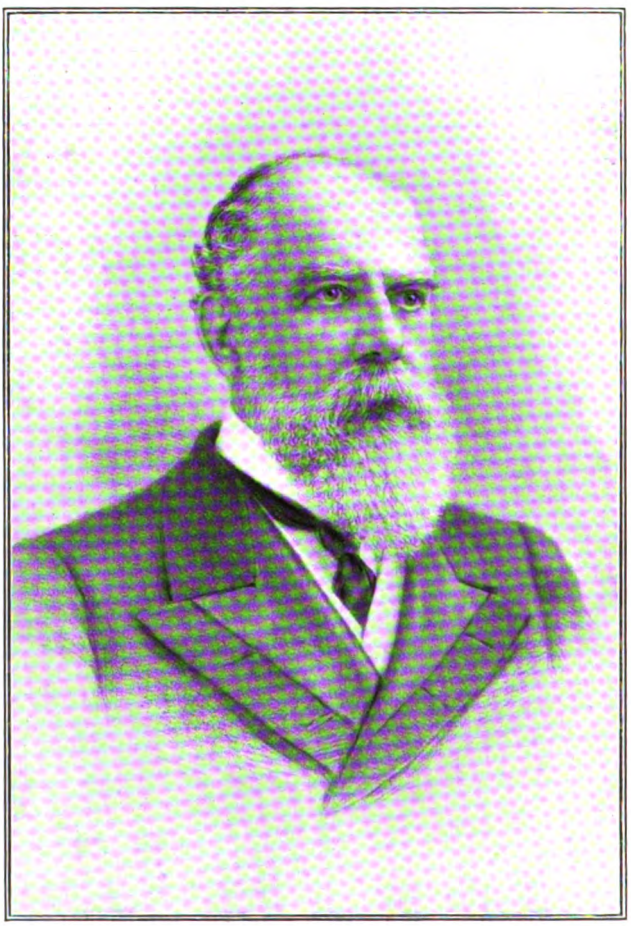

MR. HENRY SPEARMAN SAUNDERS.

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Personalities in the Wireless World

HENRY SPEARMAN SAUNDERS

Director of Marconi's Wireless Telegraph Co., Ltd.;
Director of the Marconi International Marine Communication Co., Ltd.;
Director of the Spanish and General Wireless Trust.

MR. SAUNDERS was born in April, 1841, and is the son of the late Hon. Frederick Saunders, who was Treasurer of Ceylon, an office which was occupied later by his eldest son, Sir Frederick Saunders, K.C.M.G., the brother of the subject of our sketch.

Mr. Henry S. Saunders early in life went out to Ceylon, and for twelve years interested himself in coffee planting, the most important industry of the island. He then determined to start an estate agency, and acquired large interests in different parts of the island. His reputation for energy and keen business faculties soon made him a *persona grata* with the most influential residents on the island, and amongst other positions of trust he was offered, and accepted, the Chairmanship of the Planters' Association of Ceylon. The island has good reason to be grateful for his interest and zeal, for it was due to his untiring efforts that the railway extensions in the mountainous regions of Ceylon were carried out, in spite of strenuous opposition.

As Chairman of the Ceylon Planters' Association, Mr. Saunders organised a London Agency, which has since developed into the Ceylon Association of London. Later Mr. Saunders was largely instrumental in obtaining the co-operation of an important firm of railway engineers, who offered to construct a network of light railways over the island. The Government, however, decided to carry out the work themselves on the broad gauge. This has been the means of developing important tracts of land now utilised as large tea and rubber estates. But the energies of Mr. Saunders were not yet exhausted; he next turned his attention to the upkeep of the roads in the hilly country, securing and fulfilling large contracts from the Ceylon Government in such a way as to obtain official congratulation.

But Mr. Saunders still had time to engage in social activity. He started and organised the Colombo Club, which is now one of the most important institutions of its kind in the country, and on his retirement from the Hon. Secretaryship he was made the recipient of a very handsome presentation.

In sporting circles in Ceylon Mr. Saunders will be remembered as taking a keen interest in racing; amongst his cups is that of the Ceylon Turf Club Plate. His coach, with team of English horses, is still referred to as the only one ever seen in Ceylon.

Fourteen years ago, Mr. Saunders became acquainted with Mr. Marconi, and he was then invited to join the Board of Marconi's Wireless Telegraph Co., Ltd. He accompanied Mr. Marconi to America on board the *Philadelphia* in 1902, when the first trials of wireless were carried out on the American liners, and a message was received during that voyage from Poldhu, in Cornwall, over a distance of 2,000 miles. It was owing to these successful results that contracts were made with the Canadian Government for the erection of wireless telegraph stations in Canada, and it was then that the American Marconi Company was formed, to be followed shortly afterwards by the inauguration of the Marconi Wireless Telegraph Company of Canada.

It was in this connection that Mr. Saunders' abilities for finance and organisation showed themselves to the full advantage, as, in co-operation with financiers in London and on the Continent, who were quick to recognise its immense importance and the likelihood of its far-reaching effects, the formation of the Marconi International Marine Communication Company was established, of which Company Mr. Saunders is still a director.

Mr. Saunders is married to Grace Maynard, daughter of the late Colonel Charles Oldfield, and widow of F. N. Evans-Freke, barrister-at-law.

B

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Transatlantic Wireless Telegraphy

THE NEW JERSEY STATION

GOOD progress is being made with the construction of the high-power stations which, when completed, will add enormously to the public facilities for the use of transatlantic wireless telegraphy. The Clifden-Glace Bay service, which, since 1908, has been in regular continuous communication, day and night, carrying commercial, public, and press messages, has hitherto been the only service in existence affording direct wireless communication between the Eastern and Western hemispheres. But it will not long enjoy its "splendid isolation," for other stations are now being erected which will bring the North American Continent nearer (in a telegraphic sense) to England and other European countries, thus relieving the pressure of traffic upon the Clifden-Glace Bay stations, and coping with the enormously increased use of transatlantic telegraphic communication which the cheapness and efficiency of the Marconi service has made possible.

From time to time we hope to be able to furnish our readers with details of the stations which are being erected on both sides of the Atlantic in fulfilment of this scheme. In the meantime, a few preliminary notes concerning the stations now being erected near New York may be of interest.

Site of the Transmitting Section of the New Jersey Station, New Brunswick.

Two miles out from the historic city of New Brunswick, N.J., on a road that follows the banks of the Raritan river and the Raritan canal, lies the transmitting section of the wireless station which will bring the United States in direct communication with England. Approaching the site from the south one sees a beautiful meadow stretching from the road to the canal bank. In this meadow are located the power-house, the auxiliary transmitting office, and the first set of two masts. To the west of the road

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the land rises sharply for about a thousand feet, and then runs nearly level for a mile or more. Looking up this rise the two cottages for the chief engineer and the assistant engineer are to be seen, and, further up the hill, the building which will accommodate the engineering staff, the operators required to work the auxiliary receiving apparatus and the riggers who keep the aerials and the mast system in shape.

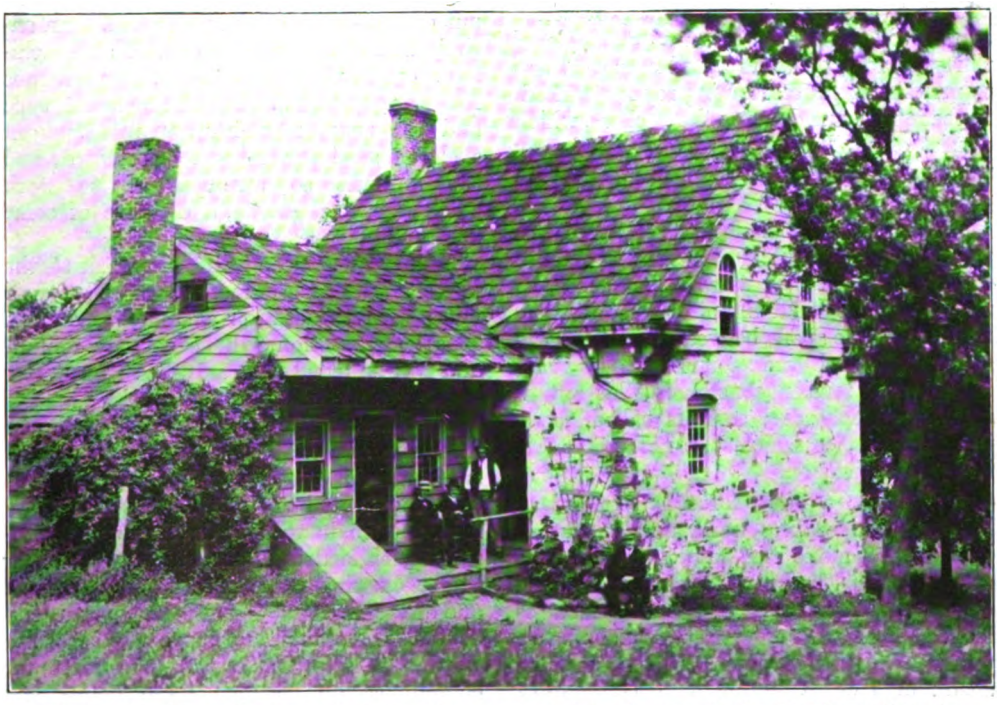
The power-house is now beginning to take shape, for the concrete work is completed up to the first story and ready for the brick work. The foundations for the motor generators are well under way, and the steel girders and beams for the first floor are being erected. A feature which cannot fail to be noted is the permanent and fireproof nature of the work on all of the buildings.

The auxiliary operating building is about 100 feet north of the power-house, has the brick work completed to the roof, and awaits the steel and roof tile to finish the structure of the building. All the buildings at this station are of rough tapestry brick, laid up with a wide joint in black mortar. With red tile roofs and an attractive design they make a handsome appearance.

An old historic farmhouse, long since past its prime, is being utilised as the construction office. This house has stood for more than one hundred and fifty years, and, judging from the appearance of the huge hand hewn timbers, will stand for another century or so. In revolutionary days this dilapidated house was a mansion of importance, having been at one time the paymasters' office of the Revolutionary Army; and rumour has it that Lafayette had his headquarters here for a time during the American War of Independence.

The receiving section of the New Jersey station is at Belmar, the road to which leads along the Shark River, a famous salt water inlet, which, during the summer months, is the resort of launches and other pleasure craft. The countryside looks rather deserted as one travels to the Marconi Station. At the station, however, all is life and bustle.

The operating house is at the foot of the



"Lafayette House." An historic dwelling converted to the use of the Staff erecting the New Brunswick Station.

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Digging Foundations for the Receiving Station at Belmar, N.J.

hill close to the river. From this building the receiving aerials will rise to the first mast located on top of the hill. Crossing the road at nearly right angles, and stretching westward for almost a mile, the aerials will be carried on the top of six masts, each 300 feet high. The back ends of these aerials will be carried down at an angle of thirty degrees, being insulated near the mast top and having steel running ropes attached. These ropes come down to the anchors, which consist of a pillar 15 feet high, with heavy iron weights free to slide up and down on them.

These weights balance the pull of the wires and are calculated to keep a definite tension in the aerial wires at all times, so that when the wind blows or sleet incrusts the aerials, the spans between the masts will sag down and the counterweights rise, keeping the tension constant. This straining pillar anchorage, as it is called, is an ingenious device which is a new departure in cable suspension.

At Belmar a large force is required to handle the operating work, and much will be done to make the residential quarters attractive to live in. Summer boating on Shark River is a pastime which is looked forward to with pleasure, while tennis and outdoor sport will be encouraged; in fact, a happy little community will soon be thriving in this neighbourhood.

AN ALASKAN CHAIN.

AS we announced last month, the American Marconi Company have in hand the erection of stations at Ketchikan and Juneau. Stations are already in existence at both of these points, but only ship business is handled. An entirely new station will be erected at Ketchikan, consisting of a 15-kw. synchronous rotating gap transmitter of the latest type and the usual receiving apparatus. Four skeleton steel towers will be erected, and the antenna so arranged as to work efficiently with Seattle, a distance of some six hundred miles to the south.

Ketchikan station will also work to the north to a distance of more than two hundred miles with the station at Juneau, Alaska. This latter station will be entirely rebuilt, and will be fitted with a 10-kw. transmitter and two skeleton steel towers.

These two stations are intended to be the first links of a chain to provide Alaska with a commercial wireless service connecting it with the United States. As business develops, the chain will be developed and provided with feeders further north.

The existing cable rate between Juneau and Ketchikan is 6 cents per word, and between Ketchikan and Seattle 19 cents per word. It is probable that the rates for communication between these points will be considerably reduced when the Marconi service is inaugurated.

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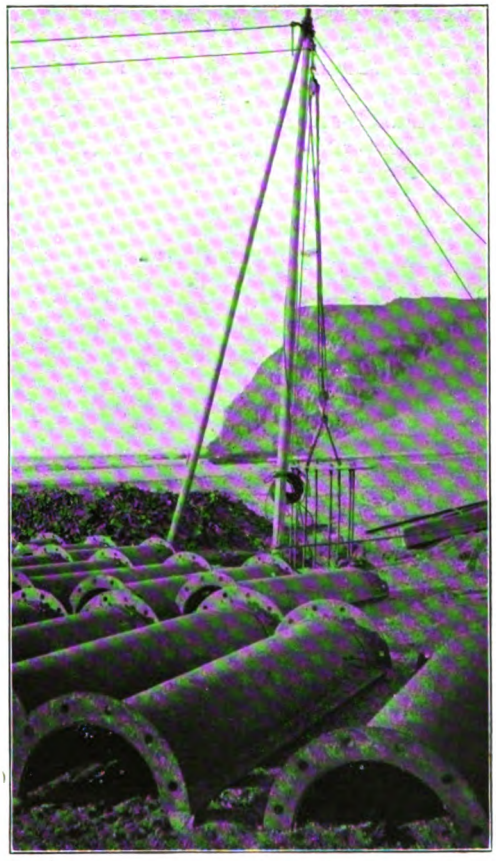
Wireless Telegraphy in Chile

COMPLETION OF THE SMALLER COAST STATIONS AT ARICA, ANTOFAGASTA AND COQUIMBO. INCIDENTS DURING THEIR ERECTION. THE CHILIAN WORKMAN. DISCOVERY OF INDIAN MUMMIES. WHERE EXTREMES MEET.

THE three smaller coast stations in Northern Chile, erected by the Marconi Company, have just been turned over to the Government. The installations are of interest, being, from a wireless point of view, by far the most luxuriously equipped stations yet erected. The plant and staff are housed in one building, suitably designed for the climatic conditions. The apparatus, as usual, is located in different rooms, the battery being interposed between the transmitting and receiving apparatus rooms, thereby ensuring a minimum of extraneous sound in the latter. The design of the transmitter is such as to ensure great flexibility of wave-length with high radiation efficiency and extreme reliability in every detail. At one end of the Antofagasta plant are located the wireless switchboards, which control all wave and coupling changes and also indicate the amount of energy radiated. Two aerials are provided in order to obtain full range of waves, from 600 to 1,600 metres, without the use of an unduly large tuning inductance. The condenser bank is of fixed capacity, and therefore a constant spark power is used for all waves. A compound motor with remote control drives alternator, disc discharger and ventilator on one shaft. A normal spark frequency of 400 is used, but adjustment above or below may be obtained by varying the speed of the motor. The alternator switchboard is provided with safety switch, frequency and voltmeters, the latter normally reading 300. The usual attendant primary inductance, transformer, signalling key with its blower and protecting chokes are of special design, preference being given in all cases to porcelain and marble insulation on account of their greater hardihood in the climate they have to withstand. Accumulators are used, the cells being burnt together, thus eliminating any possible trouble from acid fumes. The battery room



Lowering the base of the N.W. mast of the Arica Station into its pit. In the distance is seen the famous hill-fort, El Morro. The town of Arica lies immediately behind the hill.

door, wisely, opens to the outside of the building. A still is provided to prepare pure water for topping the cells. The prime mover is a 13 h.p. oil engine, which drives a 7½-kw. inter-polar dynamo. The accumulator switchboard is provided with the usual instruments, including minimum current breaker and central zero ammeter. The

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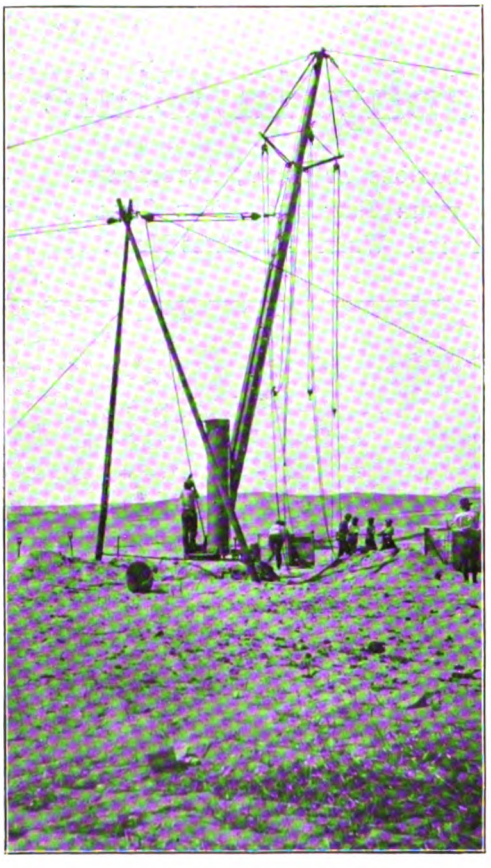

Raising the topmast of the middle mast at Antofagasta.

stations possess a complete and useful lighting system, wired with Simplex fittings and twin-conductor lead-covered cable. A valve receiver of rather longer range than usual is used for receiving.

Spares to cope with every possible breakdown are provided, as well as a very useful tool kit and set of testing apparatus.

Arica station, with its masts painted an invisible drab, lies under the shadow of El Morro, a famous and strongly fortified saddle of rock which rises abruptly between the town and the station. Antofagasta installation, to those who are on the station, seems an infinite distance from anywhere! It lies in a plain of white sand to the north of the town, twelve miles across the bay. Coquimbo is more pleasantly situated, being but two and a half miles from the town. The sites have evidently been chosen with due regard to their wireless working and the menace of a possible enemy.

Transport caused some difficulty and much work, whilst lack of water and provisions at Antofagasta did not make matters too pleasant. Further, though an earthquake shock is a very tame affair when experienced in a town of single-storied houses, those living under the shadow of a couple of steel masts are apt to regard such matters more seriously.

The country of Northern Chile, so famous for its mines and nitrate fields, can scarcely be described as interesting, though it enjoys what must be one of the most perfect climates in the world. Never too hot and never too cold, the long days of golden sunshine would bring contentment to the most exacting, if only there were some few patches of green to relieve the eternal monotony of mile after mile of rock and sand. Coquimbo is blessed with a little green, and it was a happy relief to get there after the dust and dreariness of Antofagasta.

The Chilian is an excellent workman, though all in a greater or lesser degree are subject to unduly excessive "celebrations" when they finish their week's work and receive their pay. Monday, if a full gang be needed, is a sorry day, and sorrier still if the cook is missing! These men seem to believe very strongly in the "bending reed" principle and their ready acquiescence does not mean all it ought to unless someone is on hand to remind them. They shine on contract work, and it is then that their giant strength and staying powers are brought home to one. When working day-work six men will pitifully stagger along with a case, whilst, on contract, these same men will run with it. When a contract is ended they disappear, and for days it is impossible to find one. Then after perhaps a week they begin to crawl around looking, and probably feeling, "like nothing on earth." They invariably club together after receiving their contract money and hold a celebration followed by a dance. All, or nearly all, dance, and when going through the fantastic steps of their native Cueca their enthusiasm knows no bounds.

Whilst putting in the earth plates at Arica, the men dug into a burial ground and discovered a number of Indian mummies. Perfectly preserved, but shrunken to an

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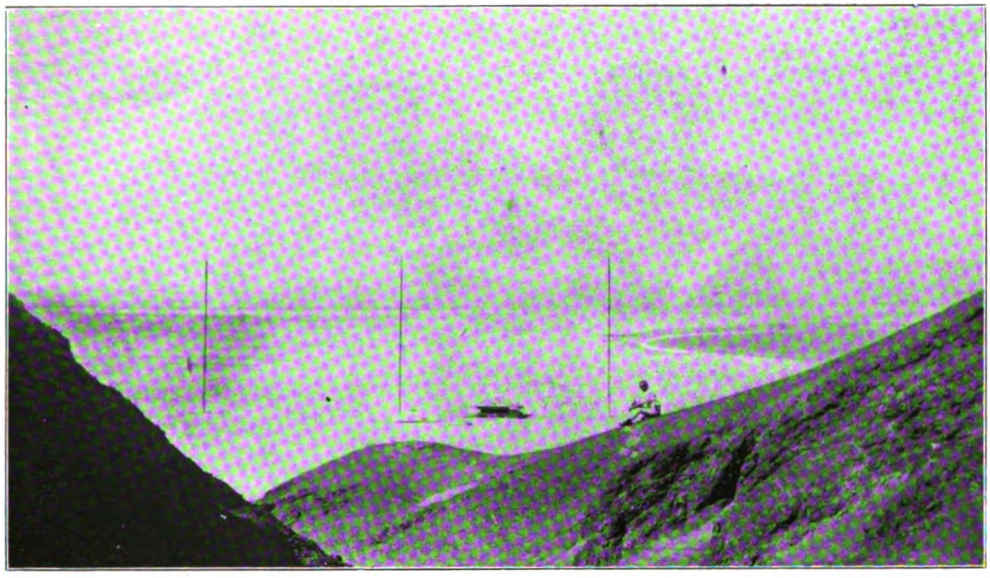
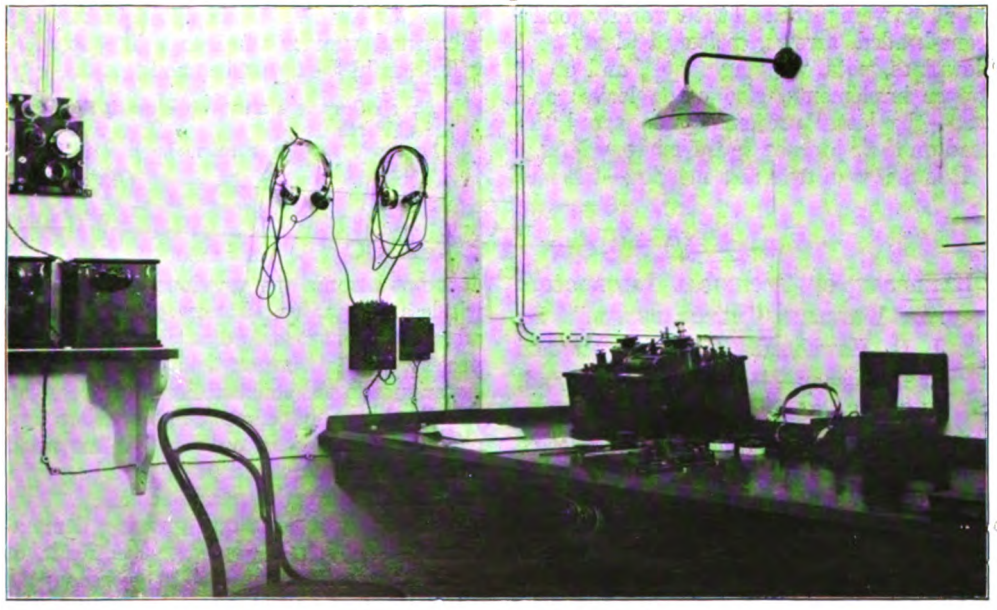


Exterior view of Antofagasta Station, taken looking towards the East. This station is situated at Caleta Vieja, which takes its name from the bay shown on the reader's right. From the station to the foot of the distant hills is a 10-mile stretch of soft white sand.



The Receiving Room of Antofagasta Station. From this room the transmitting apparatus is controlled by a system of remote control switches. The receiver used is the Fleming Valve, with necessary tuning condensers and inductances to render it responsive over very long range of wave length.

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Mummies of ancient South American Indians discovered whilst burying the Arica "earth." The view shows the stone-headed arrows, pots, corn and spinning instruments used. Most of the human remains discovered had stones tied round their necks, indicating that the bodies were those of slaves. Native chiefs were buried with precious stones in their mouths.

almost absurd size, each was strung up in rough canvas with a rope passing under the knees and knotted behind the neck. In their laps were placed all their worldly goods, stone-headed arrows, poisoned darts and blowpipes, pots, weaving spools, and crude copper implements, also cocoa leaves and corn—the latter presumably to speed the dead on their journey to their happy land.

It is a case of extremes meeting—the fact that these ancient, and to us savage, bodies are making the "earth" of the Arica station and helping in its mission of harnessing the powers of Nature. It is apt to make one think and wonder whether a like occasion will occur in the ages to come!

> . . . "Ourselves must we beneath the Couch of Earth
> Descend, ourselves to make a Couch—for whom?"
> (*Kháyyám*).

A New Text-Book

"HANDBOOK OF TECHNICAL INSTRUCTION FOR WIRELESS TELEGRAPHISTS." By J. C. Hawkhead. (London: Marconi Press Agency, Marconi House, Strand, W.C.) 3s. 6d.

We are frequently asked by prospective wireless operators and amateurs to recommend a text-book which, while within the means of a slender purse, will nevertheless serve as a sound and trustworthy guide through a course of instruction on wireless telegraphy. Mr. Hawkhead's book can be confidently recommended for this purpose. It is written in a style which will enable the student to thoroughly understand the subject with a minimum of difficulty, and it does not assume any previous knowledge of wireless telegraphy. It possesses the further advantage that it embodies the most modern practice. The author has had practical experience in the construction and operation of all classes of commercial wireless apparatus, and, as is only to be expected under the circumstances, the work bears the impress of thoroughness and accuracy. That it will satisfy a large and growing demand cannot be gainsaid, and the multitude of students and amateurs are to be accounted fortunate in having such an invaluable and, in a sense, unique text-book placed within their reach. The numerous illustrations of apparatus and diagrams form a useful feature of the book.

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Early Methods of Signalling

WHEN contemplating the marvels of wireless telegraphy from the physical point of view and in the simplest way, the startling suggestion presents itself that there is no essential difference between the flickers of the light used as signals by a savage tribesman when he waves a beacon to warn his friends a few miles away of the approach of danger, and the invisible signals that sweep across the ocean from one Marconi station to another.

In all ages, men have resorted to signals to quicken intelligence, and an interesting account of the early methods of signalling between distant points is given in Reid's "The Telegraph in America."

The first application of what is called a "telegraph," although that word (meaning "writing at a distance") belongs to the modern times, was a system of wooden blocks of various shapes, to indicate letters, arranged by Dr. Hooke, in 1684. A century later, in 1794, three brothers, named Chappé, were confined in schools in France, situated some distance apart, yet within sight of each other. Free communication, under the rigorous rules of these schools, was denied them. They yearned for intercourse. Finally, affection suggested a plan by which a pivoted beam could be used to convey the signs of letters, by pointing it in different directions. The variety of signals was enlarged by adding small movable beams at the ends of the main beam. In this way these brothers arranged 192 different signals, and, by correspondence, thereby relieved the tedium of their confinement. After their release, the system they had devised for communication with each other was exhibited to the Government of France, and adopted for a service of signals. One of the brothers Chappé became telegraphic engineer for the Government. Semaphoric signal houses and signals were rapidly established along the whole French coast, in 1803, with Chappé as manager. These were continued in use for a number of years, until electrical discovery provided the modern means for that purpose.

In 1795 Lord George Murray, of England, improved on Chappé's original plan by using two frames in which six Venetian blinds were inserted, thus adding greatly to the ease in operating and translating, as well as to the variety of the signals. Murray's system was adopted by the British Government and continued in use until 1816.

In 1807 General Pasley, and in 1816 Sir Home Popham, contrived modifications of the Chappé and Murray systems, introducing lamps for night service. Jules Guyot, of France, and Treutler, of Berlin, also perfected similar systems, but with little practical advantage over those previously in use.

In the American Revolutionary War, one of the signals employed was a flag-staff, surmounted by a barrel, beneath which a flag and basket could be so changed in their combinations that a number of announcements could be thus communicated. It will be remembered, also, how the farmers of Middlesex, Essex, and Worcester, on the night of April 18th, 1775, sprang to arms to meet the foe, having been aroused by Paul Revere, who having seen the signal agreed upon in the North Church tower, which told the movements of the British troops from Boston, had started on his famous ride to warn the people that the storm had burst.

It is a curious circumstance that, as late as 1846, signals, on Murray's plan, erected on high or prominent points of land, were used between New York and Philadelphia by some enterprising street brokers, who long kept the matter secret, using it even after the introduction of the Morse electric telegraph, and whose means of information for a long time confounded the members of the Stock Exchange. One of these gentlemen, known as Bull Bridges, when at last the Morse instrument began, in 1845, to click in the second story of the Philadelphia Merchants' Exchange, was able, by practising privately on telegraphic sounds, to catch by ear the messages coming over the wires. He could also, with his large lustrous eyes, wink a figure to a confederate conveniently waiting for the information.

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Lessons from the Army Manœuvres

THE MILITARY USES OF WIRELESS TELEGRAPHY

ALTHOUGH, from a spectacular point of view, the British Army manœuvres of 1913 have not been so effective as those of previous years, there can be no question that they have furnished much valuable instruction in the various branches of campaign work, and that they have not been devoid of results may be gathered from the speech made by His Majesty the King, who, at the close of the exercises, declared: "The lessons learned must have been particularly numerous and valuable, because of the close nature of the country, and the consequent difficulty of intercommunication and of obtaining information."

His Majesty's speech was preceded by a report on the results of manœuvres, by Sir John French, who also laid stress on this important feature of intercommunication, and we quote the passage in that speech which bears directly on the subject:

> "The system of connection between units in formation throughout the 'Brown' force was satisfactory, but the important principle of ensuring rapid communication between all parts of the force left a good deal to be desired. So many instances of this failure came under notice that I have no time to refer to them in detail. They will duly appear in the published report. In the meantime it would be advisable to turn our close attention to effecting improvement in this most necessary service."

Such an important statement was not likely to pass unnoticed, and the *Times* military correspondent, in an article which appeared later on the result of these manœuvres, enlarged on this point. He has taken the occasion to remark that it was disappointing to find on several occasions that troops in one part of the field were not aware of what was going on in another part.

The writer makes some comment upon the training of the new signalling staff, which he considers is at present inadequate. At the Army staff tour no signal companies came out, and the work of all staffs is too much divorced from that of the companies, which follow a favourite practice of the Engineers and usually seek a sequestered spot where they can train alone. It would be better were the staffs and companies, which should complete each other, to work more frequently in unison. But, even so, the writer is not convinced that the signal companies alone can be trusted to keep commanders in touch in all circumstances. Cables are frequently broken by heavy guns and wagons—a cow was found peacefully eating a cable at the Army exercise—and, in any case, it is the well-established practice of all staffs who know their business to send important messages in duplicate and triplicate by different hands and different routes.

It will be noticed that he makes no reference in the foregoing extracts to the use of wireless telegraphy in this connection. But the military correspondent of the *Morning Post* in his report states that the wireless communication worked well, but seems to have been little used.

"The reason for this," he declares, "is obvious. Wireless messages have to be sent in cipher if of any importance, and coding and decoding is unquestionably a nuisance. In time of war cipher has constantly to be used in all forms of telegraphy, and it would be well perhaps if more practice in such work were to be afforded during future peace exercises. Cryptography and its elucidation appeals to some, and officers who take an interest in such things ought to receive every encouragement to make a study of the subject. The expert can almost always decipher a message of the enemy's which has fallen into his hands in the end. But he is apt to take a good deal of time over the task, and it must often be the case

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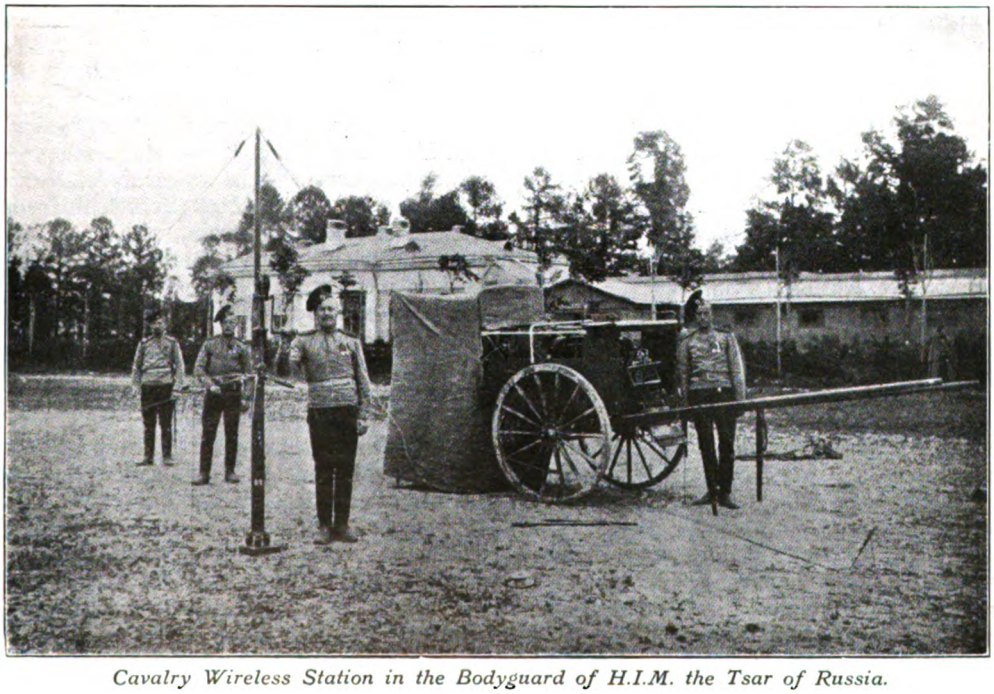
that unless the purport of the message can be discovered speedily the thing ceases to have importance."

Why these remarks should be made with regard to wireless telegraphy more than to any other system of signalling is not very obvious. Coding and decoding must always have a place in whatever system is used, and with an expert the time taken in deciphering a message is only a moment. This being so, wireless has advantages belonging to no other system of communication. It can be the least interfered with of any system, for with the invention of the wave-switch, whereby the wave-length can be altered, even during the transmission of a single sentence, the likelihood of the message being picked up by the enemy is reduced to a minimum. Again, the enemies must have a wireless station in a suitable position, and an extremely expert operator, if they are to attempt anything of this kind, and these two necessaries often preclude all danger of interference. Now, with signalling, any sharp-witted fellow with a pair of field glasses can secure the message; and as for code, it is as easy or as difficult to decipher that used in signalling as it is in telegraphy.

So it comes to this, for all practical purposes, wireless telegraphy is the nearest means of absolute security to intercommunication that the Army possesses, and its use and practice is a matter which calls for strict attention if the British Army is to attain an adequate war efficiency.

There is yet another reason why the use of wireless telegraphy should not be neglected. It is the only means of communication with airships and aeroplanes, also with the Fleet. More particular emphasis should be laid on the need for aeroplanes to be fitted with wireless, for the results of the manœuvres go to show that these are the most effective for reconnoitering purposes, as the following report proves:

More aeroplanes and airships were used this year than ever before, and the rival fleets consisted of three airships—the *Delta*, *Eta* and *Astra Torres*—with 25 aeroplanes belonging to the White troops (the defenders), and 13 aeroplanes, including four monoplanes, but no airships, belonging to Brown's troops (the invaders). By means of wireless telegraphy the *Delta* was able to send reports of the movements of the Brown troops to White's headquarters.



Cavalry Wireless Station in the Bodyguard of H.I.M. the Tsar of Russia.

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Radio-Telegraphic Investigations

Work of a British Association Committee

By W. ECCLES, D.Sc. (*Secretary to the Committee*).

AT the Dundee meeting of the British Association (September, 1912) an interesting debate, opened by Prof. Fleming, took place on the problems raised by Wireless Telegraphy, and as a consequence the Mathematical and Physical Section of the Association appointed a Committee, with Sir Oliver Lodge as Chairman, to see what could be done in the way of furthering radiotelegraphic investigation. One of the facts that appealed strongly to the Committee when they met was that there were numerous amateurs scattered about the country who were waiting, one might say, for a lead in wireless telegraph investigation. Without some lead, such as might be offered by the Committee—or alternatively in occasional instances by a friendly expert or man of science—many an amateur will do little with his apparatus except tap the messages that happen to fly over his station, or take down the time, or play at telegraphy with another amateur in the locality. The Committee, when they came to survey the field open to radiotelegraphic research, kept in mind the possibility of obtaining the assistance of amateurs, and in arriving at a decision they tried to settle upon branches of research that were both important and, in the circumstances, feasible.

Every point of view that occurred to the Committee urged them to promote the investigation of such of the mysteries of wireless telegraphy as are met with by observers distributed over a wide area—that is to say, of such phenomena as occur on the grand scale.

Chief among these universal phenomena is that of the natural electric waves which have coursed about the globe since the most remote ages, but the existence of which was completely unsuspected till very recent times. These natural electric waves cause erratic and troublesome noises in the telephone receivers of a wireless telegraph station, or cause erratic and confusing marks on the tape of a coherer and inker set. They are only too familiar to everyone who has worn the 'phones of a wireless operator for even a brief interval. For brevity they were christened "strays" or "X's" in the years 1897, 8 and 9 in England, and were later given the name "atmospherics" in the United States. Another and more recent Americanism is "static." The best name appears to the writer to be "strays," for the word exactly describes their vagrant nature, and does not commit one to any opinion as regards their origin. The much-used word "atmospheric" suggests that they are wholly due to discharges of atmospheric electricity, and no doubt the word "static" is intended to convey the same idea. "Atmospherics" is, besides, a dreadfully long word to have to write often. From the point of view of brevity "X's" is the best term, but it is not quite accurate. On the whole, from the point of view of priority, of accuracy, of freedom from ambiguity, and of the absence of bias—not to mention reasonable brevity—the writer favours the term "stray" as the best short term for a natural electric wave-train, with "X" as a good variant. The latter term may be held to include, as "stray" does not, the noises caused by discharges of local atmospheric electricity down the antenna.

Now, to the scientific mind, the chief claim of stays to promptness of attention is that nobody knows completely what they are or whence they come. The study of strays was begun by Popoff shortly before the rise of practical wireless telegraphy. In 1895 Popoff made use of a long vertical conductor (such as a lightning rod) in combination with a coherer, in order to follow the motions of lightning storms across the country. A filings coherer was used, and was automatically tapped back after

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registering the effect of each lightning stroke. In 1898 Boggio Lera improved on Popoff's apparatus as regards sensitiveness, and arranged that feeble and strong disturbances should be recorded separately. His experiments with this apparatus in 1899 showed that the approach of electrical storms was heralded by frequent operation of the apparatus several hours in advance of their arrival in the locality of the observing station, and showed also that every visible flash operated the apparatus infallibly. These results were confirmed in 1900 by Tommasina using his carbon auto-decoherer. In 1901 Fenyi showed that the thunderstorms occurring within 100 kilometres of his station at Kalocsa, Hungary, were all recorded by his coherers. Finally, Turpain, in 1903, made a long series of observations which proved the possibility of utilising radiotelegraphic apparatus in the forecasting of thunder weather for hours and even days in advance.

But even when there is no thunder weather recorded over the whole continent of Europe and the adjacent seas, X's may be received almost perpetually by a receiving antenna adjusted to a great wave-length. This is quite a distinct matter from the X's due to local atmospheric electricity utilising the antenna as a lightning rod, and different again from the hum or sizzle or fizz caused by a white squall at sea or by glow discharge to high peaks. These perpetual strays are characterised by the fact that they are heavier and more frequent, in general, the longer the wave to which the receiving antenna is adjusted, so far as has been tried up to the present. It is natural, but it is not scientific, to jump to the conclusion that these strays are all due to lightning strokes occurring probably at great distances somewhere on the earth's surface, or possibly in the free atmosphere between one bank of ionised air and another. This, however, ignores the possibility that the source of the strays may be far outside the earth. There is nothing unreasonable in supposing that the sun, let us say, may send us occasional electric waves. For example, in the colossal movements of matter associated with the formation of a solar prominence—movements that appear to take place with enormous velocities—electric discharges may be brought about of magnitude far transcending anything that can happen on the earth. These would give rise to electric waves which might reach the earth in perceptible intensity and constitute a proportion of our strays. On the other hand, we must not forget that we on the earth's surface may be protected by our ionised atmosphere from these extra-terrestrial waves. It is just such problems as these that the British Association Committee has set itself to inquire into as soon as they can persuade a sufficient number of widely-dispersed observers to co-operate. The exact method to be pursued in this matter will be described fully in an early announcement by the Committee.

Another and distinct inquiry which urgently needs pursuing has regard to the part played by the earth's atmosphere in causing variations in signal strength. The laws of these variations, especially in respect of their connection with weather conditions, with the time of day, and with position on the earth's surface, require investigation. The time of day has effects that include the now well-known sunset and sunrise variations; and, as regards the other points mentioned, we only know at present that the barometric height does affect signals, and that the barometric height is associated with geographical position in very definite and remarkable ways. In order to learn more we must have observations made simultaneously at various parts of the world and collated at a central office.

As has been said before, the Committee is bound to look very largely to amateurs for the collection of data on these and kindred subjects. But it has been a matter of extreme gratification to the Committee to find that the Imperial Navy and the British Post Office each were willing to lend a hand. Not only that, the Marconi Company also has, with most commendable public spirit, promised to give its powerful assistance to the Committee. Thus the Committee can already make tolerably sure that data will be collected by ships in every sea; and it is hoped that similar data will before long be collected at many fixed points of the globe. All these data will be collected and analysed by the Committee; and it will be disappointing indeed if great additions are not rapidly made to our scientific knowledge of the problems that have been raised by this great new branch of engineering.

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Electromagnetic Waves employed in Radio-Telegraphy*

By Prof. G. W. O. HOWE
City and Guilds (Engineering) College, South Kensington.

IF power be transmitted by means of continuous current from one point to another, not, as is usual, by two parallel circular conductors, nor by a concentric cable, but by two wide strips of thin copper placed face to face and close together, both the magnetic and the electric fields will be approximately uniform throughout the space between the strips in any plane section normal to the direction of transmission. For this reason the consideration of such a transmission line proves an excellent method of approaching such conceptions as are involved in Poynting's theorem and electromagnetic wave phenomena. Although this method has its limitations it will be seen to yield important results. After considering the continuous current case, it will be shown that by using the same transmission line for alternate currents one is led to a clear conception of the nature of those gigantic electromagnetic waves which, emanating from a "wireless" aerial, spread over the earth in every direction. It will be shown that some of the fundamental ideas commonly accepted and taught in text-books on radio-telegraphy are fallacious.

Considering first the transmission of energy by means of continuous currents, let i be the current in amperes and e the P.D. in volts. If the resistance of the strips be neglected, the latter will be constant from end to end of the line. If b is the width of the strips and d the distance between them, the strength of the magnetic field between the strips is easily shown to be

$$H=\frac{4\pi i}{10\,b}.$$

If the strips are very close together H will be constant in the space between them and zero elsewhere. The same is true of the electric field, the strength of which is given by the formula

$$E=e/d \text{ volts per centimetre.}$$

H and E are evidently at right angles and their product

$$HE=\frac{4\pi ie}{10\,bd}.$$

Now the power transmitted is ie watts or joules per second, and this power is transmitted through the dielectric space between the strips and not through the strips themselves, which merely act as guides. The walls of a speaking tube act in very much the same way in guiding the energy which is transmitted as sound waves.

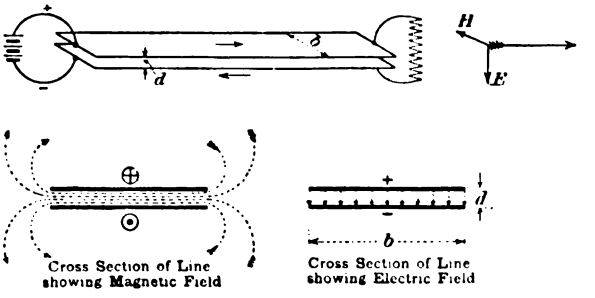

FIG 1

The energy transmitted across each square centimetre of dielectric cross-section will be

$$\frac{ie}{bd}=HE\times\frac{10}{4\pi} \text{ joules per second.}$$

Thus, at any point in space where there is simultaneously a magnetic field, H, and an electric field, E, at right angles, there is a transmission of energy in a direction at right angles to the plane of H and E, equal to

* Read before the British Association.

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$\frac{10}{4\pi}$HE joules per second or watts, where E is expressed in volts per centimetre. This is Poynting's theorem. The relative directions of H, E and the transmission of energy can be seen from Fig. 1 to be represented by the first and second fingers and the thumb respectively of the left hand, set mutually at right angles.

If the line is opened at the receiving end the current ceases and there is no magnetic field, but only the electric field. If the line is short-circuited the P.D. between the strips falls to zero, and with it the electric field, leaving only the magnetic field. In neither case, however, is there any transmission of energy. For energy to be transmitted the electric and magnetic fields must exist simultaneously in the same space, and must be, to some extent, at right angles to each other. This is an important point often overlooked when considering the nature of the electromagnetic waves by which energy is radiated from an antenna; we shall return to it later.

The inductance of the line per centimetre of length—that is, the flux produced in the space between the conductors by unit current—is evidently $\cdot\frac{4\pi d}{b}$ absolute units, or $\frac{4\pi}{10^9}\cdot\frac{d}{b}$ henries.

The capacity between the strips per centimetre of length is $\frac{b}{4\pi d}$ absolute units, or $\frac{b}{4\pi d}\cdot\frac{1}{9\times10^{11}}$ farads if the dielectric is air.

We shall now assume that the dynamo or battery is replaced by an alternator with a frequency of $\sim$ cycles per second, and that the load at the far end of the long line is non-inductive. Every centimetre of the line has a certain inductance, L, and a certain capacity, K, the values of which we have

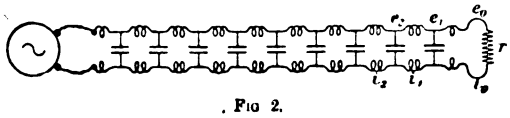

FIG 2.

just seen. The actual line could be replaced approximately by a number of inductances and condensers arranged as in Fig. 2. The conductor resistance and the leakage are both assumed to be negligible. A vector diagram can now be built up by assuming a current through the non-inductive load and gradually working back along the line in the usual way. The vector diagram is greatly simplified, however, if the resistance, r, constituting the load at the end of the line, is made equal to $\sqrt{L/K}$. (This ratio is a very important characteristic of the transmission line; it is sometimes called its surge impedance. By German writers it is called its "Wellenwiderstand"—*i.e.*, wave-resistance.)

If $r=\sqrt{L/K}$, the vectors of both current and voltage maintain a constant length—that is, an ammeter placed anywhere in the line will give the same reading, as will also a voltmeter connected between the lines at any point. In addition to this the two vectors will be in phase at every point. This can be readily seen from a consideration of Fig. 3. If i be the root-mean-square current at any point, the voltage drop per

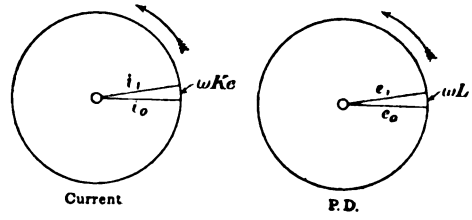

FIG. 3.

centimetre at that point will have a root-mean-square value of ωLi ($\omega=2\pi\sim$), and will be 90 degrees out of phase with the current. If e be the P.D. between the lines at any point, the capacity current per centimetre at that point will have a R.M.S. value of ωKe, and will be 90 degrees out of phase with e. For the current and voltage vectors to maintain a constant length and rotate together it is obviously necessary that $\omega Ke/i=\omega Li/e$.

Since $e/i=r$, this is equivalent to $r=\sqrt{L/K}$. With a load of this value the energy is absorbed as fast as it arrives, and there is no reflection back along the line to cause stationary waves. The result is just the same whether the line is short or long. At those points along the line where the current, and therefore the value of H, is a maximum at any moment the P.D., and therefore also the value of E, will be a maximum at the

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same moment (Fig. 4). The rate of energy transmission in watts per square centimetre is given at every point, at every moment, by the formula $\frac{10}{4\pi}$HE.

If the non-inductive load be replaced by a choking coil of negligible resistance, or by

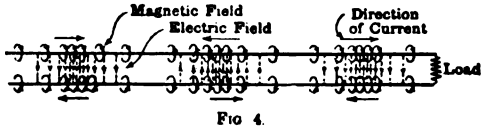

FIG 4.

a condenser with negligible losses, the voltage and current vectors will be 90 degrees out of phase, not only at the end, but all along the line. This is easily proved, because the voltage drop is at right angles to the current vector and the capacity current is at right angles to the voltage vector at every point. The current in the line at any moment is a maximum when the P.D. is zero, and *vice versa*, so that we have alternately a storage of magnetic energy and a storage of electrical energy, but no resultant transmission of energy. In this case we have stationary waves on the line.

Returning now to the case of the non-inductive load, the velocity of the wave along the line is easily found from Fig. 3. The inductive drop per centimetre is ωLi; for a length l the drop is ωLil, and this is set off around the circumference of the circle described by the vector e. If we take such a length along the line that $\omega Lil = 2\pi e$, we arrive at a point where the phase is the same as at the end; this value of l is therefore the wave-length λ.

Hence,

$$\lambda = \frac{2\pi e}{\omega Li} = \frac{2\pi}{\omega\sqrt{KL}} = \frac{1}{\nu\sqrt{KL}},$$

and the velocity of the wave

$$= \lambda \cdot \nu = \frac{1}{\sqrt{KL}}.$$

Substituting the values of K and L, we have

$$\frac{1}{\sqrt{\frac{b}{4\pi d}\cdot\frac{4\pi d}{b}\cdot 9\times 10^{20}}} = 3\times 10^{10}\text{cm. per second.}$$

Hence, the electromagnetic wave travels along the line with the velocity of light.

We have seen that the ratio e/i is constant all along the line and equal to $\sqrt{L/K}$; therefore, $\frac{Li^2}{2} = \frac{Ke^2}{2}$, that is, the total energy in each cubic centimetre of the dielectric space is at every moment equally divided between the magnetic and the electric fields. The total energy in 1 cm. of the line is $Ke^2_{in.}$, where $e_{in.}$ is the instantaneous value of the P.D., and the average value of the energy per centimetre is Kc^2, where e is the R.M.S. value of the P.D. This energy is being transferred with the velocity $v = \frac{1}{\sqrt{KL}}$, and the amount of energy arriving at the far end in a second will be

$$Ke^2 \times \frac{1}{\sqrt{KL}} = e^2 \times \sqrt{\frac{K}{L}} = \frac{e^2}{R} \text{ joules.}$$

The electromagnetic waves in the space between the two strips are of the simplest possible type—viz., plane waves. If the two strips are made several hundred miles wide and several hundred feet apart, and if the lower strip is replaced by the earth, no essential change is made in the nature of the waves; it is simply a matter of scale. We should then have sweeping over the surface of the earth plane electromagnetic waves. In many problems connected with radio-telegraphy it has been assumed for the sake of simplicity that the waves employed are of this type.* It may be objected that, in the case of radio-telegraphy, we have not a transmission free from loss with a non-inductive load of a certain definite value at the far end. In the theory of the propagation of telephone currents it is a well-known and easily proved fact that for a long line in which the energy is dissipated before it arrives at the far end, where it might otherwise be reflected, the apparent impedance of the line is equal to $\sqrt{I/Y}$, where $I = R + j\omega L$ is the impedance of unit length of the line and $Y = G + j\omega K$ is the admittance of unit length (G is the reciprocal of the insulation resistance, $j = \sqrt{-1}$ and $\omega = 2\pi\nu$). If R and G are small compared with ωL and ωK, the apparent impedance of the line will be simply $\sqrt{L/K}$, and the current at the sending end will be in phase with the applied P.D. so that the line

* Zenneck, "Annalen der Physik," 1907, Vol. XXIII. p. 846.

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appears to be non-inductive. This will also be true if R/L=G/K, which is the condition for Oliver Heaviside's distortionless transmission line. In the case of radio-telegraphy the damping is small, especially over the sea, and we make little error in assuming that the current and P.D., or, as we must say if we refer to the space between the conductors and not to the conductors themselves, the magnetic and electric fields are in phase.

We can, however, approach much more closely to the actual radio-telegraphic waves by assuming that the two parallel strip conductors radiate from the alternator in all directions. The upper strip now becomes an upper disc and the lower strip a lower disc, or merely the earth, while the alternator is imagined to be connected between the centres of the discs. All round the edges of the discs, which we imagine to be of enormous diameter, we can assume a non-inductive load of the correct value to be uniformly distributed, or, more in accordance with facts, the resistance of the lower disc (the earth) may be assumed to dissipate the radiated energy so that none ever reaches the limits of the discs. The transmission will, however, be no longer perfectly distortionless, unless we assume that the leakage bears the necessary relation to the resistance, but this is a point of minor importance.

The magnetic flux will be distributed concentrically around the generator in alternate belts in opposite directions, there being no flux except between the discs. Passing outwards from the centre of the disc one would pass through successive belts of current flowing alternately radially outwards and radially inwards. At every point in either disc there is an alternating radial current.

The radiation of energy is in this case strictly cylindrical, but is otherwise identical with the radiation from a "wireless" antenna. The electric and magnetic fields in the neighbourhood of the lower disc are identical in their nature with those near the earth, but the variation with the distance from the generator is different.

This want of agreement is entirely removed by making the height of the upper disc above the lower vary directly as the distance from the centre, or, in other words, by replacing the upper disc by an inverted cone, as shown in Fig. 5. The alternator is connected between the apex of the cone and the point of the earth almost in contact with it. This suppositious arrangement not only gives a radiation of electromagnetic waves almost identical with that of wireless telegraphy, but at the same time lends itself to very simple calculation. Contrary to the case of the two parallel discs, the inductance per radial centimetre of this new multi-directional transmission line is constant—*i.e.*, independent of the distance from the origin—as is also the capacity per centimetre. In this respect the inverted cone arrangement is similar to the ordinary telephone line or the two flat strips already considered, and leads to the same simple formulæ and the same vector diagrams.

CALCULATION OF THE ANGLE a BETWEEN THE CONICAL SURFACE AND THE EARTH.

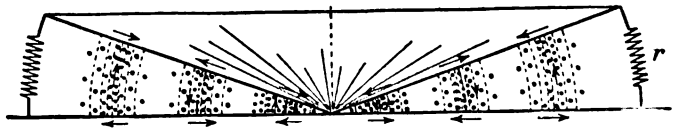

FIG. 5.

To calculate the inductance per radial centimetre we have to find the flux per radial centimetre when unit current flows steadily outwards in the cone and returns radially to the centre of the lower disc. Let a be the angle between the cone and the lower disc, x the distance from the centre, and d the distance between the cone and the earth, measured along the circular arc, then $d=ax$. The length of the magnetic path is $2\pi x$, and the flux per radial centimetre for unit current is $\frac{4\pi d}{2\pi x}=2a$, and the inductance per centimetre is, therefore, $2a \cdot 10^{-9}$ henry. The capacity per radial centimetre is obviously that of a plate condenser with plates of area $2\pi x$, separated a distance d, which is $\frac{2\pi x}{4\pi d}=\frac{1}{2a}$ absolute units, or $\frac{1}{2a\times 900{,}000}$ mfd.

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Hence, apart from damping, the current and the P.D. will vary from point to point exactly as in an ordinary telephone line with these values of inductance and capacity per unit length. The strength of the electric field E at any point is found by dividing the P.D. at the point by the distance between the cone and earth, which varies as the distance from the generator. Now we have already proved that, apart from damping, the P.D. has the same amplitude all along the line, hence the strength of the electric field E will vary inversely as the distance from the centre. Again, since the length of the magnetic path varies directly as the distance from the centre, the magnetic field strength H must vary inversely as the distance. This agrees with the results obtained for the radiation of electro-magnetic waves from a Hertzian oscillator or antenna. It is seen, therefore, that, taking the earth as the lower disc and replacing the upper atmosphere by the perfectly conducting inverted cone, a system of electromagnetic waves is generated and propagated, and these waves are identical in their nature and properties—at least, in the neighbourhood of the earth—with those electromagnetic waves employed in radio-telegraphy, and vary in intensity from point to point on the earth's surface in exactly the same way. This radiation cannot be called cylindrical, but is essentially spherical, the wave fronts being approximately portions of spheres.

Although this supposititious arrangement gives the correct values of E and H, near the surface of the earth, this cannot be so for the upper atmosphere, where, instead of ending normally on an upper conical surface, the electric field forms loops as shown in Fig. 6.

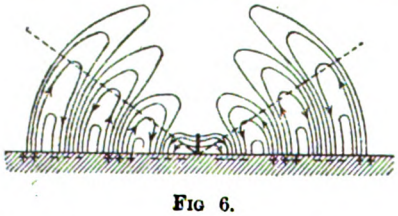

FIG 6.

If one is merely considering the question from a qualitative point of view, the slope of the upper conical surface is immaterial. To make quantitative calculations, however, the angle must be so chosen that the total amount of energy in the advancing wave bears the same relation to the values of H and E near the earth's surface as it does in the actual radio-telegraphic wave. The correct value of this angle is easily calculated. On the assumption of a perfectly conducting flat earth, the strength of the electric and magnetic fields at the earth's surface due to a vertical aerial is given by the following equation* :

$$E = H = \frac{2i_{max.}}{10} \cdot \frac{\cos\left(\omega t - \frac{\omega x}{v}\right)}{x},$$

where $i_{max.}$ is the maximum aerial current in amperes,

$\omega = 2\pi \sim$,

x = distance from aerial in centimetres,

and v = velocity of light in centimetres per second.

Therefore, $E_{max.} = H_{max.} = \frac{i_{max.}}{5x}$ c.g.s. units,

or $$E_{max.} = \frac{i_{max.}}{5x} \times 300 = \frac{60\, i_{max.}}{x} \text{ volts}$$

per centimetre.

Again, the total power radiated from a vertical aerial is $\frac{0{\cdot}61\ I^2}{v}$ ergs per second,† where I is the amplitude of the antenna current in electrostatic units. Putting the current in amperes and $v = 3 \times 10^{10}$, we have

$$\frac{0{\cdot}61 \times i^2_{max} \times 9 \times 10^{18}}{3 \times 10^{10}} \text{ ergs per second}$$

$$= 18{\cdot}3\ i^2_{max.} \text{ watts}$$

$$= 36{\cdot}6\ i^2_{R.M.S.} \text{ watts.}$$

Now in the supposititious case of the inverted cone and the perfectly conducting lower disc, the amplitude of the total radial alternating current is the same at all distances from the centre, and the length of the magnetic path is $2\pi x$. The strength of the magnetic field at a distance x will therefore be

$$H_{max.} = \frac{\frac{4\pi}{10}\, i_{max.}}{2\pi x} = \frac{i_{max.}}{5x}$$

and the electric field

$$E = \frac{\text{P.D.}}{d} = \frac{i\sqrt{\frac{L}{K}}}{ax}$$

$$= \frac{i}{ax}\sqrt{\frac{2a\ 10^9}{1 \quad 1}} = \frac{i}{ax}\sqrt{3{,}600a^2},$$
$$2a \cdot 9 \times 10^{11}$$

* Abraham, "Theorie der Elektricität," Vol. II. p. 300.

† Abraham, *loc cit.*, p. 304.

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and $E_{max.} = \frac{60}{x} i_{max.}$ volts per centimetre.

(Note.—$H_{max.} = E_{max.}$ if the latter is expressed in electrostatic units.)

Now the apparent resistance of our transmission line is $\sqrt{L/K}$, and the power supplied to it by the alternator, and therefore transmitted along it is

$$i^2_{R.M.S.} \sqrt{\frac{L}{K}} = i^2_{R.M.S.} \times 60\alpha \text{ watts.}$$

In the case of the actual aerial the power radiated is $36{\cdot}6\ i^2_{R.M.S.}$ watts. Hence, for the radiated power to be the same in each case, we must have

$$60\alpha = 36{\cdot}6, \text{ or } \alpha = 0{\cdot}61 = 35 \text{ degrees.}$$

This angle can be found in another way without considering the apparent resistance of the transmission line. We have seen that by Poynting's theorem the power transmitted across a square centimetre is equal to $\frac{10}{4\pi}$ H . E watts. The maximum power per square centimetre will therefore be

$$\frac{10}{4\pi} \cdot \frac{i_{max.}}{5x} \cdot \frac{60\ i_{max.}}{x} = \frac{30\ i^2_{max.}}{\pi x^2} \text{ watts,}$$

and this will be the radiation at any point at the moment when H and E have their maximum values at that point. Since both H and E vary according to a sine law, the average rate at which energy is transmitted across each square centimetre is equal to half the maximum—viz., $\frac{30 i^2_{R.M.S.}}{\pi x^2}$ watts. The total radiation is

$$\frac{30 i^2_{R.M.S.}}{\pi x^2} \times 2\pi x \times \alpha x = i^2_{R.M.S.} \times 60\alpha \text{ watts,}$$

as found by the other method.

Hence, if the arrangement of inverted cone and lower disc is to give a correct representation of the actual radio-telegraphic waves, as regards both H and E and the total radiated energy, the angle α cannot be such a small angle as in Fig. 5, but must be exactly 35 degrees, as shown in Fig. 7.

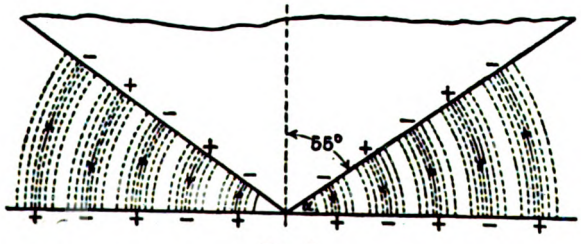

FIG. 7.

It will be evident from the foregoing, and especially from Fig. 4, that the vertical electric field is a maximum at any point at the same moment that the magnetic field at the same point is a maximum. The writer has found that there is a prevalent idea that the successive bands of vertical electric flux sweeping out from the antenna with the velocity of light *alternate* with bands of magnetic flux. This is not so; the electric and magnetic fields occupy the same space at the same moment, and the successive bands are separated by spaces in which both H and E fall simultaneously to zero. This is only true, however, if we avoid the immediate neighbourhood of the antenna. The current in the antenna, and therefore its magnetic field, are zero at the moment when the P.D., and therefore also the electric field, are approximately at a maximum. It is important to notice, however, that if the current and P.D. were exactly 90 degrees out of phase, the antenna oscillation would be wattless, and there could be no radiation of energy. The radiation has a similar effect to the introduction of an additional resistance in the antenna, and constitutes the useful load on whatever may be used to maintain the oscillation. In the immediate neighbourhood of the aerial there are powerful magnetic and electric fields, which are nearly 90 degrees out of phase, and which produce, for the most part, an oscillation, as distinct from a transmission of energy. It is only the components of H and E that are in phase which can cause a transmission of energy, and the other components are negligible beyond a certain distance from the antenna.

If there were no radiation the antenna could be represented by an equivalent inductance, capacity and resistance forming a closed oscillatory circuit, as in Fig. 8, where I is the spark-gap circuit and II the equivalent aerial circuit. In Fig. 8 a new cause of damping can be introduced into circuit II by opening the switch *s*, viz., a transmission line, which, if infinitely long and free from

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losses, acts exactly as an additional non-inductive resistance in the circuit. Here it is evident that a part of the oscillating energy is now transmitted away along the line and

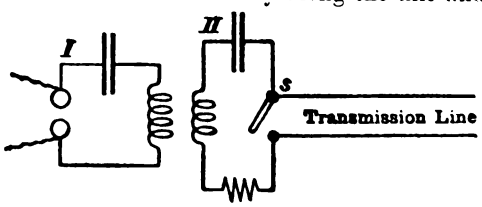

FIG. 8.

that in this line current and P.D. are in phase.

As a striking example of the prevalence of the idea that the electric and magnetic fields succeed one another alternately at any given point, it may be mentioned that in the first edition of Professor Fleming's "Elementary Manual of Radio-telegraphy," the fourth chapter, dealing with electro-magnetic waves, was permeated with this fallacy, as the following quotations show. (This has been corrected in the second edition, published three years ago.) "At the same point in space the electric component is a maximum at the instant when the magnetic component is zero and *vice-versa*; in other words, the two vectors differ 90 degrees in phase," and again, "we should detect these regions of magnetic flux and electric strain alternately succeeding one another at that place." It is interesting to notice how this view was given the appearance of mathematical support. The two fundamental equations are:

$$\frac{d^2H}{dt^2}=\frac{1}{\mu K}\cdot\frac{d^2H}{dz^2}$$

and

$$\frac{d^2E}{dt^2}=\frac{I}{\mu K}\cdot\frac{d^2E}{dz^2}$$

where z is measured in the direction of propagation. The error was then made of taking as their solutions:

$$E=E_0 \sin 2\Pi\left(\frac{z}{\lambda}-\frac{t}{T}\right)$$

and

$$H=H_0 \cos 2\Pi\left(\frac{z}{\lambda}-\frac{t}{T}\right)$$

which, of course, supports the view that E and H are 90 degrees out of phase. The use of the *sine* in one solution and the *cosine* in the other is quite arbitrary, however, and in order to satisfy the equation

$$-\mu\frac{dH}{dt}=\frac{dE}{dz}$$

the same function, sine or cosine, should be used in the solutions for E and H.

The physical meaning of this is easily seen from Fig. 9, which represents the values of H and E at various distances from the source at any moment. The arrow shows the direction of propagation. At A the flux through the small stationary rectangle is not changing, while at B the rate of change is a maximum. The E.M.F. or the line-integral of E around the rectangle is zero at A—*i.e.*, the value of E is the same along each of its vertical sides—whereas at B dE/dz is a maximum. Hence H and E are in phase.

The same is true in a sound wave. Our sending antenna is here replaced by an organ pipe in which we have stationary waves, with a stationary distribution of pressure at one moment, succeeded after a quarter of a cycle by an equal-pressure distribution of velocity. The maximum velocity occurs at points a quarter of a wave-length away from the points of maximum pressure. When sound waves travel through space, however, the conditions are different: the compressional waves are in phase with the velocity waves, *i.e.*, the air particles which have the maximum compression or maximum rarefaction at a given moment are those which are moving with the greatest velocity.

Returning now to the electromagnetic waves travelling over the earth's surface, we have seen that the calculated strength of the

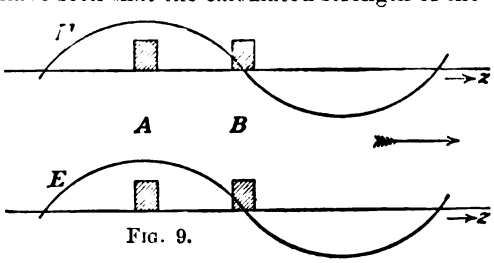

FIG. 9.

electric field near the surface is $60i/x$ volts per centimetre, where i is the current in the sending antenna. This field is normal to the surface—*i.e.*, it is a vertical field. These results are confirmed by experiment if the distance from the sending antenna is not too great. The distance at which marked discrepancies appear depends on the wave-length employed and especially on the nature of the earth's surface. These discrepancies are to be expected because we have made three assumptions:

(1) That the earth is a perfect conductor, whereas dry soil might be better described as a poor insulator; (2) That the earth is flat; and (3) That the atmosphere is a perfect and uniform dielectric at all heights.

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The Goldschmidt Wireless Patents

Acquired by the Marconi Company—Important New Concessions

AN extraordinary general meeting of Marconi's Wireless Telegraph Co., Ltd., was held on October 4th for the purpose of submitting to the shareholders a resolution authorising the increase of the company's capital by the creation of a further 500,000 Ordinary shares of £1 each to rank *pari passu* with the existing 750,000 Ordinary shares except as regards dividends declared for the period of the current year. This resolution was passed unanimously, and subsequently confirmed at the further meeting held for that purpose on October 20th. The directors of the company decided to make an immediate issue of 250,000 of the shares and offer them to the shareholders at the price of £3 5s. per share. Of the remaining 250,000 shares part will be issued for cash in connection with the arrangements which have been made with respect to the shares to be acquired in the Cie. Universelle de Télégraphie et Téléphonie sans Fil of France, and the balance for the present will remain unissued.

Mr. G. Marconi presided over the meeting and moved the resolution, which was seconded by Mr. G. C. Isaacs, who made an important statement in regard to it.

Important Concessions.

The recommendation to increase the company's capital did not come as any surprise to the shareholders, for it was general knowledge that wireless telegraphy had become a very important industry not only in this country and in Europe, but in nearly every country in the world. It is destined to play a very important part in the future telegraphic business of the world, and shareholders were aware that the policy of the Marconi Company aimed at conducting that telegraphic business for its own account wherever it might be possible. Considerable progress has been made in that direction in recent times, and a number of important concessions have been secured, which will provide to the company the means of organising telegraphic services with some of the busiest commercial centres of the world. Negotiations are pending with other countries, and, said Mr. Isaacs, they had every reason to believe that they would be brought to a satisfactory conclusion in the near future. To fulfil the terms of the concessions and create such telegraph services a number of stations have to be built, requiring a substantial expenditure. As each station is opened and a satisfactory telegraphic service conducted, for which he thought they could safely rely upon their scientific advisers and engineers, an additional important, regular and continuously increasing revenue would accrue to the company.

To illustrate the scope for wireless telegraphy, Mr. Isaacs said :

"Additional and cheaper means of communication between all the busy centres of the world, together with the ever-increasing commerce, should add very considerably to the sum which is to-day expended upon the world's telegraph messages. I think I am right in saying that the money expended yearly for telegraphic communications across the seas is already sufficient to pay satisfactory dividends upon a capitalisation which I believe exceeds £100,000,000 sterling, independently of the increase which may be reasonably expected through the advent of wireless telegraphy and the general development of the world's trade ; and when we shall have completed the work which lies before us, and secured, if only a small share of the telegraph business, it should prove sufficient to enable us to earn substantial dividends upon what I think we shall be able then to regard with our million and a half sterling as a very moderate capitalisation, considering the extensive telegraph routes which we shall control. Given efficient management of our company's affairs during the next two or three years, I am confident we shall then find that we own

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one of the biggest and most important industries in the world, capable of holding its own against any competition, and furnishing remunerative returns to those who have supplied the capital and aided in the creation of an enterprise carrying the name of one with whom we are all proud to be associated."

The remainder of Mr. Isaacs' statement concerned the acquisition of the Goldschmidt patents. He said:

"You will have learned also from the circular sent to you that we are acquiring a large number of shares in the Cie. Universelle de Télégraphie et Téléphonie sans Fil, which company owns the rights throughout the world, with the exception of the interior of Germany, of Dr. Goldschmidt's high-frequency alternator and his other wireless patents. I wish to say a word or two to you with reference to these arrangements in order that there may be no misunderstanding. The Cie. Universelle de Télégraphie et Téléphonie sans Fil is a company registered in France with a subscribed capital of 10,000,000 francs, in 100,000 shares of 100 francs each, and 100,000 *Parts Bénéficiares*, or founder shares, which participate in the profits to the extent of 45 per cent., thus making the capital equal to nearly 20,000,000 francs, or £800,000. This capital was subscribed by a few important and very influential persons, who wield considerable power in certain countries abroad. Their board is composed of men of eminence and ability in France, Germany, and this country, and their support of the Goldschmidt system, no matter what might be its merits—and upon this subject I shall have a word or two to say later—represented a serious menace to our programme in certain countries. We did not fear their competition, but we were anxious that they should not prevent or delay our obtaining certain concessions to which we attached the utmost importance. The company is in possession of some 7,500,000 francs, or £300,000, in liquid capital, and therefore in this respect also carried no small weight in the foreign countries to which I have referred.

"From every point of view—and in using these words I mean to cover something more than the interests of our Company—it appeared to your directors to be of the utmost importance that we should assure the telegraph services which are embraced in our programme becoming an English enterprise under the control and direction of an English company. These are some of the considerations which induced us to make the arrangements we have made with the Compagnie Universelle de Télégraphie et Téléphonie sans Fil. We are satisfied with the conditions we have obtained, and believe we have entered into transactions which will prove beneficial to the Company. All the shares in the Compagnie Universelle de Télégraphie et Téléphonie sans Fil which were previously held in Germany pass into our hands, and all the German directors retire from the board—a consideration of no small importance in France, and one which we hope will enable the Compagnie Universelle, who will also probably hold the Marconi long-distance licence for France and the French colonies, to secure the whole of the important business in wireless telegraphy which is comprised in the programme of the French Government. It is probable that the Goldschmidt patents for the rest of the world will become the property of the Marconi Company."

The Goldschmidt High Frequency Alternator.

"Now with regard to the Goldschmidt high frequency alternator, this is an extremely clever machine for the generation of continuous waves. It has been erected in a station near Hanover which Mr. Marconi, one of his ablest engineers, and I visited a few weeks back. There is great merit in the invention, and Professor Goldschmidt is no doubt a very able engineer. But it should be understood that he has not invented and does not claim to have invented a system of wireless telegraphy, but a machine for the generation and utilisation of continuous waves. The station in Hanover is well designed, and of great promise; it has succeeded in sending across the Atlantic signals and even messages, but, as we have told you on frequent occasions, there is a great difference between sending signals and messages and conducting a continuous telegraphic commercial service; and the Hanoverian station, in our opinion, without the assistance, experience, and patents of the Marconi Company, is still a very long way

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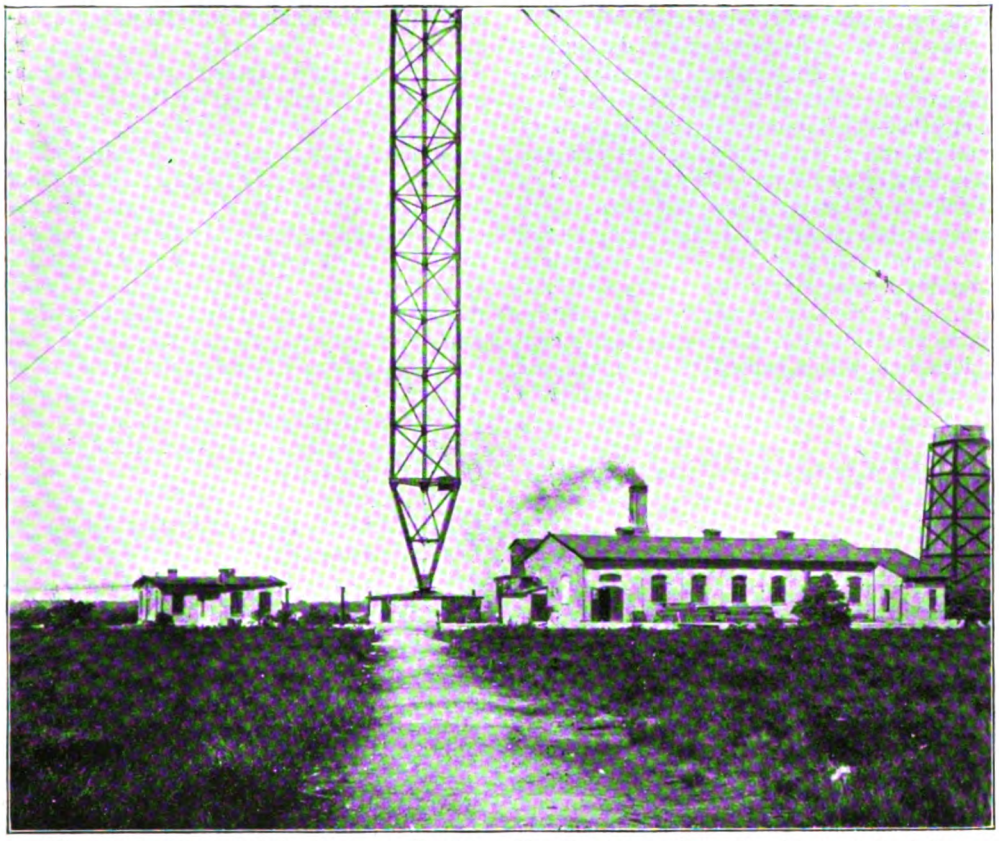

The Power House of the Hanover Station. The Receiving House is shown on the left.

Tuckerton Station, showing the foot of the Steel Tower.

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from being able to conduct such a service. In saying this I do not want to be understood to be taking from Professor Goldschmidt one whit of the merit to which he is entitled—on the contrary, his is the only method other than those of the Marconi Company of which we have any knowledge, which, in our opinion, has any prospect of success; but it is natural that a long period of tests, experiments, and further inventions would be necessary with Professor Goldschmidt, as they were with Commendatore Marconi. However, there were many considerations which caused us to make the arrangements we have, some of which I have already referred to."

The House of Commons Committee and the Company.

"There is one about which I must say a few words. We have had, as you know, a Select Committee of the House of Commons and an Advisory Committee composed of scientific men. That Committee reported that the Marconi Company alone was able to carry out the Government work at the present moment, but it nevertheless spoke of Professor Goldschmidt's machine in words which would have served the Compagnie Universelle as a certificate with any foreign Government, and consequently provide the means of seriously impeding, if not damaging, this Company's programme. It would have been little or no satisfaction to us to see the Cie. Universelle obtain a contract or a concession abroad, and fail two or three years later to fulfil it; for even though it fell subsequently to us to carry out, it would not have compensated us for the delay or the prejudice we should have suffered meantime. These are considerations of importance which obtain to-day, but in a very short time, we hope, they will no longer exist; the important foundations of our business will have been securely laid, and no interference with our programme can then arise.

"It has been stated that one of the reasons which induced us to enter into this transaction was that the station at Hanover had succeeded in transmitting wireless messages to Tuckerton, U.S.A., at a regular rate of 100 words per minute for hours at a stretch. There is not an atom of foundation for that statement, for no better reason than that the Hanoverian station has not done anything of the kind, nor anything approaching it. It has also been said by a paper, which is usually more accurate in its statements, that Lord Parker's Committee reported that the future is likely to belong to continuous waves, which is the Goldschmidt and not the Marconi system, whereas what in fact the Committee reported was that the only continuous wave machine which they had seen tried with success over long distances was the Marconi continuous wave machine. A good deal more has been written upon this subject, mainly with the object of attacking the Government in connection with the contract for the Imperial stations, but these are matters which do not concern us—they are political, and the Marconi Company has no politics."

Continuous and Non-Continuous Waves.

"But when the public is told, as one paper has told them, that the nation's interests have been sacrificed, I for one protest, for it would seem to me that the course we have taken will prove to be of very marked advantage to the nation, and that for the following reasons. We do not know, and nobody yet knows, whether continuous waves will be able to do a continuous long-distance commercial service. If they can, will they prove superior in any way to the non-continuous waves? Those who have no experience of long-distance wireless telegraphy may be willing to express their opinions, but Mr. Marconi and his engineers who have such experience decline to express themselves. Before doing so they wish to see what we are about to do—namely, work the continuous and non-continuous waves side by side across the Atlantic, and compare them at all times and in all weathers. Similarly, we shall be able to test the Goldschmidt continuous wave machine, and compare it in every respect with the Marconi continuous wave machine. If the continuous wave prove to be superior to the non-continuous, we shall be in a position to decide which of the two machines is the better; we shall preserve an absolutely open mind, and adopt whichever offers the greater advantage, and Mr. Marconi will be the first to insist upon that course.

"Should the Goldschmidt machine prove the better, the nation will have the benefit

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of it under the contract with our Company without any extra cost, and without having run any risk whatsoever. Had the arrangement which we have entered into not been made, the Government would not have had the opportunity of such a comparative test, but if it had, does anybody suppose, if the superiority proved to be with the Goldschmidt machine, that the German and French interests would have been willing to furnish it on any better terms, if as good, as those entered into with this Company? The Government has dealt with an English company; if the foreign machine prove of advantage, the Government still get the benefit of it through an English company. Is that how the nation's interests have been sacrificed? And, again, if the Goldschmidt machine prove to be of the value that some contend, and markedly superior, as it pleases others to say, to the Marconi machine, the commercial wireless telegraph business of the world would have been in the hands of foreign companies, whereas by our arrangements it will be in the control of an English company. Is that a sacrifice of the nation? I will say no more upon that subject. I hope I have said enough to convince you that whether the Marconi continuous wave machine, or the Goldschmidt continuous wave machine, or the combination of the two, prove the best in wireless telegraphy, the Marconi Company will possess them all, and under the contract the nation will have the benefit of them."

PORTABLE METEOROLOGICAL STATION.

AT the recent French Army manœuvres an interesting adjunct to the aviation corps was a motor-car ingeniously fitted up with apparatus for the observation of meteorological conditions. It was used to give the military aviators serviceable indications regarding the direction and velocity of the wind at different altitudes up to about 10,000 ft.

Comprised in the apparatus are :—(1) Two instruments called "dhéodites," which are used in conjunction with a telescope for observing the angle of elevation of a small pilot balloon, and which enable graphs of the speed and direction of the wind to be issued within a quarter of an hour of the time of making the observation; (2) several pilot balloons and cylinders of hydrogen for inflating them; (3) a pneumatic mast, which can be run up to a height of 75 ft., and which serves to carry an anemometer and also acts as a receiving antenna for wireless telegraphy, the wireless weather reports being thus received from the Eiffel Tower; (4) two kites with winders and about 14,000 ft. of steel wire; (5) the usual instruments for meteorological observations, such as hygrometer, barometer, and anemometer; (6) a dynamo; (7) an instrument for determining the velocity of the clouds; (8) a writing table; and (9) a pneumatic inflator.

The engine of the car is used to actuate the winders, run the dynamo, and work the pneumatic inflator when the mast is being erected.

SAILORS AND WIRELESS.

AN emergency committee meeting of the Executive Council of the National Sailors' and Firemen's Union of Great Britain and Ireland was held at Maritime Hall on October 14th, at which, according to reports appearing in the Press, it was decided to consult the members as to whether they would be prepared on and after May 1st next year to refuse to engage on any ocean-going cargo vessels unless they were equipped with wireless telegraphy.

The council, it is added, were convinced that, but for the fact that the *Volturno* and the ten rescuing vessels were equipped with wireless, the whole of the lives on the *Volturno* would have been lost, and were of opinion that many lives that are now lost on cargo vessels could be saved under similar circumstances were all vessels fitted with wireless.

At a meeting of the Institute of Radio Engineers (New York), held on October 1st, at Columbia University, Mr. Roy A. Weagant, Engineer of the Marconi Wireless Telegraph Co. of America, read a paper entitled "Some Recent Radio Sets of the Marconi Company." The paper discussed the design and construction of modern efficient quenched spark apparatus.

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Modern Wireless Apparatus

The Marconi Short-Range Multiple Tuner

The installation of wireless telegraphy on cargo vessels, and even small tramp steamers, has necessitated the design of special instruments, a form of which is described below.

IN all departments of physics in which we are concerned with vibrating bodies or systems of any kind we find ourselves confronted with the phenomena which are generally described by the term "resonance." This term was originally coined in connection with certain effects noticed in acoustics, but, its real significance being dynamical, it has been generalised and extended. In wireless telegraphy it is known as "tuning." A receiving circuit consisting only of an aerial with a magnetic detector connected between it and the earth would not be of very much use in actual practice. It is necessary also to introduce some means of varying the time-period of the circuit, in order to place it in resonance with the frequency of any particular transmitting station with which it may be desired to communicate. In 1908 the "standard" Marconi multiple tuner was designed. This instrument contains the inductances, capacities, and coupling arrangements required in a tuned receiving station. The whole is included in a case little over a foot long, and on the outside of which are dials indicating wave-lengths and other measurable quantities such as inductance by coupling directly. Since that time, however, the range of applications for wireless telegraphy has considerably increased, and with it has grown the demand, for certain purposes, for smaller instruments. The successful development of the ½-kw. marine set is in the main responsible for the production of the short-range multiple tuner which forms the subject of the present article.

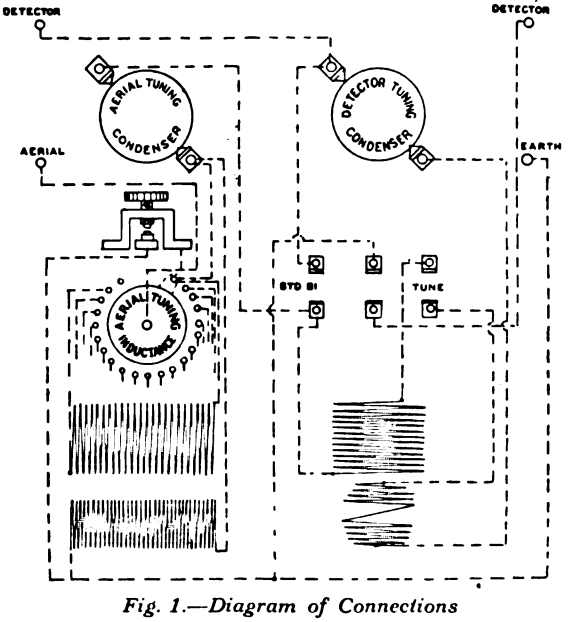

Fig. 1.—Diagram of Connections

The Marconi multiple tuner is the outcome of many years' experimental work and experience, both in regard to the scientific principles involved and the manner in which they have been carried out, the electrical and mechanical design being such that, while the instrument fulfils its functions accurately and easily, it will stand severe climates and comparatively rough usage. The principal function of the instrument is to "tune" the receiver or render it immune from interference from other stations; but it may also be used for measuring the lengths of the received waves.

The design of the instrument is such that it is completely protected from all electrical discharges, and is adequately insulated wherever required, while all switches and contacts are of the most substantial charac-

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ter and easily accessible for cleaning. Further, it is strongly constructed, and all electrical connections are carefully soldered so that it is unaffected by the severest vibration. The general appearance of the instrument is shown in Fig. 2 and a complete diagram of the connections in Fig. 1. The whole instrument fits into a plain wooden travelling case, measuring approximately 1 ft. 2 in. by 9 in. by 11 in. high, and is suitable for all wave-lengths from 250 to 750 metres.

The instrument contains two separate circuits, which are known as the aerial and detector circuits, the former being so called because it passes from the aerial through the aerial tuning inductance, tuning condenser, and inducting coil to the earth. The detector circuit consists of inductance in series with the detector tuning condenser and the detector. Both the aerial tuning inductance and the condensers are adjustable, and by this means the circuits can be tuned to the received wave-length. The oscillations in the aerial circuits then induce oscillations in the detector circuit.

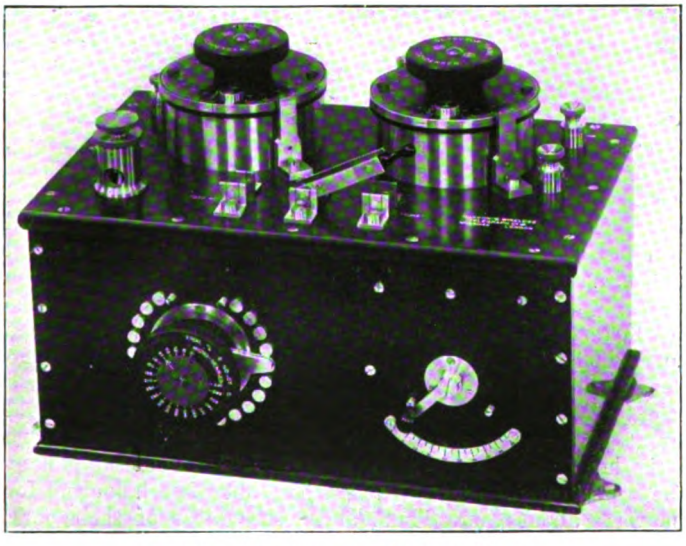

Fig. 2. Short-Range Multiple Tuner

The instrument is further fitted with a micrometer spark-gap and shunt inductance, connected between the aerial and the earth terminals to prevent the accumulation of any electrostatic charge in the aerial.

A change switch is provided, and by means of this the whole of the tuning circuits may be cut out.

When in use the tuner is on a table in front of and close to the magnetic detector.

The terminals in the tuner marked "Detector" are connected up by short pieces of wire to the primary terminals of the magnetic detector.

The aerial and earth should be connected to the terminals of the tuner marked "Aerial" and "Earth" respectively.

By turning the micrometer spark-gap screw (left-hand thread) until the contacts meet, then turning the screw back one complete turn, a gap of about one-hundredth of an inch is obtained. With the change-over switch on the "Stand-Bi" side the aerial is now connected directly through the aerial tuning condenser and inductance and the magnetic detector to the earth, and the operator will hear any station that happens to be working. Unless the aerial is very long, the aerial tuning condenser is kept "shorted" while "standing bi."

When the signals are heard from the station with which it is required to communicate, it is necessary to adjust first the aerial tuning inductance and then the aerial tuning condenser till the strongest signals are obtained.

The intensifier handle should be set to 90°, and the change switch thrown over to "Tune," and the detector tuning condensers varied till the best signals are obtained. It is then that the aerial tuning condenser should be again adjusted to give the strongest signals, and if interference is found, the intensifier handle should be adjusted to a smaller value, and the condenser again adjusted.

It will be found that the further the intensifier handle is turned from 90° the sharper will the adjustments of the condensers become, and the greater will be the freedom from interference.

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Wireless—The Life Saver

How it brought Aid to the Burning "Volturno"

THE world was horror-stricken with the fateful news it received on October 11th, that the *Volturno* had been burnt out, and 136 souls had been lost in the disaster. But terrible as this loss is, it is not the destruction of life which makes the tragedy notable in the annals of the sea; it is the fact that over 500 were saved, through the instrumentality of wireless telegraphy, out of the fiery jaws of death, when the elements, as it seemed, were combining together for their destruction. It is the most wonderful story of rescue that has yet been recorded, for the odds against which humanity fought to save humanity were as fearful as imagination could conceive. But it is a triumph for wireless telegraphy. For by this agency alone was it possible to carry out the work of rescue and bring relief to the doomed ship.

While in mid-Atlantic the *Volturno*, a British steamship carrying over 600 emigrants from Rotterdam to New York, and a heavy cargo, took fire. The extent of the damage was only too apparent. Swiftly the flames spread throughout the hold, and soon the forward part of the vessel was enveloped in flames. This was about 7 o'clock on Thursday morning, October 9th, and already the loss of life was considerable, for it is recorded that 50 or more of the *Volturno's* passengers and crew had been lost. Then the captain ordered the wireless operator to telegraph a call for help, and the first to receive the intelligence was the Cunard Liner *Carmania*, whose captain immediately set out to her rescue. A stiff gale was blowing, but in spite of this hindrance the ship covered the 78 miles which lay between her and the *Volturno* in a little more than four hours. Immediately Captain Barr received the call, he used the wireless telegraph installation on his vessel to repeat the appeal for aid over a wider range, with the result that shortly after the *Carmania* arrived at the burning ship other vessels steamed up. They were the Nord-Deutscher Lloyd steamships *Grosser Kurfurst* and *Seydlitz*; later arrived the Atlantic Transport liner *Minneapolis*, Furness, Withy & Company's *Rappahannock*, the Russian Steam Navigation Company's *Tzar*, the Leyland Company's *Devonian*, the International Mercantile Marine Company's *Kroonland*, and the French steamer *La Touraine* of the Cie. Générale Transatlantique. They found the forward end of the *Volturno* burning fiercely and the ship rolling heavily. Already they had learnt from the captain, by wireless, that six boats had been launched, but only two had got safely away, the other four had been smashed to pieces by being dashed against the ship's sides, and the occupants had been either killed or drowned, while the *Volturno's* screws had been fouled and rendered useless by the tackle used in lowering the boats. But the worst feature of the situation lay in the fact that the onlookers could render no effective aid. The seas ran so high under a north-westerly gale that no boat could approach the burning vessel and live. One crew from the *Carmania* made a gallant effort to reach her, but after labouring for two hours and losing most of their oars, they were forced to return. Then Captain Barr made a daring attempt to manœuvre his own ship close to the *Volturno*. He got within a hundred feet of her, but in the storm it was impossible to pass a line. As a matter of fact, even if this feat had been accomplished, it would have been to little purpose, for with the ships rolling as they were in the turbulent sea, the strongest cable would have snapped like thread, and as for working a cradle, that was beside the question. Towards nightfall the gale moderated slightly, and the rescue vessels were able to lower boats, but it was still impossible to get alongside, and all they could do was to look for struggling swimmers in the water, and they were aided in their work by the searchlights of the *Carmania*. About 9 o'clock that night the flames burst through

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amidships from the engine-room and bunkers; then came an explosion, and a flight of rockets from the doomed ship was the signal that hope had been abandoned, and that the vessel herself was in the last extremity.

How awful the scene was, the words of one of the onlookers on the *Carmania* affords some indication. "The spectacle," he says, "of the *Volturno* burning, with over 600 souls on board, surrounded by the huge hulls of this trans-Atlantic fleet, crowded with thousands of spectators, all eagerly anxious, but unable to help owing to the mountainous seas, beggars description."

The spectacle of the blazing ship on the ocean waves. This illustration appeared exclusively in the "Daily Sketch," and is reproduced here by kind permission of the Editor.

At 9.20 the wireless operator of the *Volturno* had to change over to the emergency batteries, as the fire, reaching the boilers and engine-room, put the pumps and dynamos out of commission. Then he sent the last despairing message, poignant with agony, which must have burned into the ears of all that received it, "For God's sake help us, or we perish." But there was little to be done until Captain Barr, who throughout had been organising the relief with wonderful skill and energy, realising that the only chance of effecting a rescue lay in the abatement of the storm, or by calming the waves by pouring oil on them, ordered his operator to ask by wireless far and wide: "Is there any oil-tank boat in the neighbourhood?" A reply, which will long be remembered in the annals of ocean disasters, came from the skipper of the *Narragansett*: "Yes, will come with the milk at six in the morning." She was seventeen hours' steam from the spot where the *Carmania* was standing by the burning ship. "Can't you make it an hour earlier?" interrogated the wireless. "Yes," came the reply, "I will be with you by five o'clock."

And she was. At day-break on Friday morning she took up a position a little to windward of the *Volturno*, and, opening her oil tanks, poured two large streams of oil on the water, and this enabled a flotilla of boats to gather at the stern of the *Volturna*, and rescue work was carried on apace. By 9 o'clock the remaining 521 passengers and

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crew had been taken safely off, and a feat of rescue work was accomplished which will stand high in the records of heroism and life saving, and must be a lasting tribute to the efficacy of wireless telegraphy. Had it not been for this, the greatest invention of a great age, the *Volturno* and all aboard her must have inevitably perished, for she would have been burnt out, and the lonely ship with her living freight would have been consumed by the greedy flames, with only a wide waste of waters to give an added horror to approaching dissolution.

This story of rescue emphasises in a particular way the value of the emergency gear, which is supplied with all ship installations. The gear consists of a set of accumulators capable of transmitting messages over distances of 100 miles. Had it not been for such a gear the *Volturno's* apparatus would not have been able to work as long as it did, as the ship's dynamo was put out of action. As it was, the operators were enabled to send messages up to the very last. That is to say, until the cabin became too hot for further occupation. This gave the vessels coming to the assistance of the *Volturno* the advantage of arranging the course they were to pursue long before they reached the disabled ship, so that not a moment was wasted in effecting rescue work. The Marconi Company inaugurated the system of emergency sets many years ago, and the advantages of this practice were later recognised by several States, who made the equipment of passenger vessels with this emergency gear compulsory.

The reports of the operators on board the various ships which went to the relief of the *Volturno* make vivid reading. Any one of these, printed in detail, would be too long for insertion in THE WIRELESS WORLD, but the general report of the operator on the *Carmania*, Mr. Maltby, is too interesting a document to be overlooked, and we print it practically in its entirety, to give some idea of the amount of work entailed in the reception and dispatch of messages at such a crisis. It may be stated that 95 messages passed through the hands of the operator on board the *Narragansett*, and many of these were a hundred words in length. The heaviest work fell to the operators on the *Carmania*, as this vessel was in touch with all the other vessels at one time or another, and the report that "the working of all stations concerned was excellent, and that of the *Volturno* especially so. The operator worked with all his power until the dynamo had ceased running, and then on the emergency gear until he was forced by heat to leave the cabin," speaks volumes for the Marconi apparatus.

The operator on the *Minneapolis* confirms this statement, for in his report he says: "I may say that the wireless work has been splendid, all ships working well, no jamming, no repetitions, and at good speed. The operators on the *Carmania* and *Volturno* did famously."

We conclude with Mr. Maltby's report:

"On Thursday, October 9th, 1913, at 10 a.m. GMT, I received an S. O. S. call from the s.s. *Volturno*, giving his position '49.12 N-34.51 W. Nr. 1 and 2 holds blazing furiously please come at once.' I immediately replied to him, and then informed the captain, who told me to tell him we were coming at once. The watch in stokehold and engine-room was immediately double banked, and instead of doing 15½ knots as previously, we started on our journey towards him on about 20 knots, as can be seen when we covered the 78 miles which separated us in four hours. A tremendous N.W. gale was blowing and a very high sea. Arriving there at a little before 2 p.m. GMT, the *Volturno* was smoking very heavily forward of the funnel, and all the time seemed to be lying in a trough, never rising on the waves. I told all ships in the vicinity to stand by, as the *Volturno* was in distress. Messages were sent from all those within range of us to the captain, asking for information, and when given it, also hurried to the spot.

"Immediately we got to her we went as close as possible and lowered a boat, but it was impossible to reach her, and after a dangerous and strenuous two hours returned unsuccessful.

"The *Volturno's* aerial was now earthing badly, of which fact I informed him, and according to later reports it was repaired by the second officer, who fell from a height of 20 feet on to the deck. After having been asked by the *Volturno* to look for the two missing boats, we had only gone about 5 miles when he asked us to return, saying,

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Some of the Operators who took part in the thrilling tragedy of the sea.

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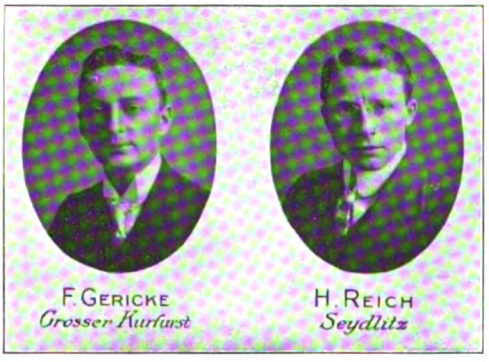
'Come as quick as possible, she may go down any minute, plates buckling.' We returned, and went dangerously close to her, and lowered six rafts, to no avail. Nothing could be done, so we stood by.

"Gradually one by one all the other ships arrived, till at midnight eight were around her, our captain having kept all well advised as to the position, which was constantly changing. In the 25 hours that we were there she drifted over 40 miles.

"It was one of the most heartrending sights I have ever seen. To see the *Volturno*, one mass of flames from funnel to forecastle, surrounded by all these ships incapable of doing anything. Men and women on our ship were seen in tears, and if the captain had thought it advisable and called for volunteers, the whole ship would have



The Operators on the German Vessels.

volunteered undoubtedly. At 10.50 the *Volturno's* lights went out, and the operator was working on accumulators. The operator on the *Volturno* deserves all praise, for he stuck splendidly to his post, even when the flames were as high as the funnel, and all the time worked with a steady head and a coolness which under the circumstances was remarkable.

"Almost his last message ran: 'We can't last much longer, can't anything be done to help us?' One felt like going out and getting in a boat and attempting to get to him by oneself. Before daybreak the seas subsided somewhat, and ships began to lower their boats, one of the first, I believe, being the *Devonian*. The *Carmania* now lay a little further away, and gave way to more navigable and smaller vessels. By 9 a.m. all had been taken off, and after the ships had cruised around on a fruitless look-out for the missing boats, they proceeded on their diverse journeys.

"It was certainly one of the most nerve-racking experiences I have ever had, and all who saw it will certainly agree with me.

"(Signed) P. B. MALTBY,
"s.s. *Carmania*."

Some Press Comments

"THE TIMES."—The grief and horror which the fate of the *Volturno* must everywhere cause will be mitigated in part by the reflection that but for the recent application of modern science the disaster would have been yet more terrible than it is. . . . Had it not been for the invention of wireless telegraphy and the equipment of so many great liners and others with it, it is almost certain that all the 657 human beings on board the *Volturno* must have perished.

"THE DAILY TELEGRAPH."—Owing to the miraculous intervention of science ten liners are bearing to different ports no fewer than 521 survivors. Who could have foreseen when first the wonders of wireless telegraphy were whispered in incredulous ears that in a few short years it would have made the Atlantic ring with anguished calls for succour and to have led to the salvation of scores of lives?

"MORNING POST."—The beneficent part which wireless telegraphy now plays in the saving of life at sea has again been demonstrated by the disaster to the *Volturno*. The distress signals sent through space brought to the aid of the burning liner quite a fleet of steamships. Owing to this equipment it is now well-nigh impossible for a passenger vessel to disappear from human ken without the slightest indication of her fate, as has occurred in former days, as practically all liners of importance carry an installation.

"DAILY MAIL."—The immense value of wireless telegraphy in protecting life at sea is demonstrated once more in the tragedy of the *Volturno*. . . Grievous as is the death roll of 136, but for wireless telegraphy, the world might have had to mourn the loss of every soul on board the *Volturno*.

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P.O. Wireless Telegraphists

THE minutes of evidence given before the Select Committee which was appointed to inquire into the wages and other conditions of employment of the principal classes of Post Office servants are interesting to us inasmuch as they deal with the claims put forward on behalf of wireless operators by representatives of the Postal Telegraph Clerks' Association.

The Committee recommend that the staff should be recruited from telegraphists, counter clerks and telegraphists, and sorting clerks and telegraphists of not less than 21 years of age or over 24 years of age, and that an officer before being transferred on probation to the wireless staff must be a thoroughly competent telegraphist, and before transfer on probation, but not necessarily before selection, must show proof of such knowledge of French and German as is necessary for communicating with foreign ships. Every officer transferred to the wireless staff should be regarded as a probationer for two years, and be liable at any time during those two years to be returned at the discretion of the Post Office to the class from which he has come without loss of seniority.

Every wireless operator must, in addition to his purely operative duties, render to the officer in charge of the station every assistance in his power which may be required towards keeping the wireless station in an efficient condition or to effect temporary or permanent repairs in the plant.

As the watch must be continuous throughout the year, the Committee see no reason to discriminate between day and night hours, Sundays, Bank Holidays, or ordinary working days. They accordingly recommend that a wireless operator be required to perform 45 net hours duty per week by day or night, spread over six days in each week, but that on one day he should be entirely off duty, and if called upon to work on that day should receive pay at rate and a half, as recommended for other classes on Sunday.

The Committee recommend that the wireless staff should be allowed one calendar month's leave in every year, inclusive of Bank and other general holidays.

The overseer or other officer in charge of the station should perform such manipulative duties, including the keeping of a wireless watch, as the exigencies of the service may require, but he should not under normal circumstances be scheduled to perform these duties for more than 4 hours per diem.

The Committee consider that the Department ought, wherever necessary, to provide official residences for the staff, for which a reasonable rent should be charged, and where it is found that the convenience of the staff is best met by placing these residences in a village some little way off rather than at the station, there should be at every station comfortable accommodation for rest, including, in case of emergency, sleep.

The following scale of pay is recommended :—

Wireless Class.—1st year, 32s. ; 2nd year, 35s. ; 3rd year, 40s., on passing technical and manipulative examination and being accepted on the staff ; then by annual increments of 3s. to 70s.

Wireless Overseers.—£200 by £7 10s. to £230, and that the overtime should be paid on the system recommended in the report.

Finally, the Committee recommend that officers at present employed on wireless duties should be transferred to the new Wireless Class with all the conditions attached on the following basis :—

(*a*) Manipulative officers to enter the new class at the minimum of the new scales, or at the actual pay they are at present receiving unless they have two years' service on the class, in which case, on passing the technical examination, or if they have already obtained the certificates required for the technical allowance and are certified by the Inspector of Wireless Telegraphy as fully efficient, they may be accepted on the staff and proceed on the scale of pay recommended for officers on passing the technical examination and being accepted on the staff.

(*b*) Wireless overseers to enter the new scale of pay carrying the pay they are actually receiving and proceed on the scale recommended.

D

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More Answers to Correspondents

BY OUR IRRESPONSIBLE EXPERT

N. PARKER (Lowestoft).—What you want is a library, not an answer to a question.

* * *

WILLIAMS (Bristol).—For an explanation of why the night range of a wireless station is greater than the day range, see answer to TOMPKINS (Londonderry) given below.

* * *

QUERIST (Stratford-on-Avon).—A buzzer is an electric bell with the irritating parts amputated.

* * *

MISS N. (Wimbledon).—Yes, there *have* been lady operators, but the last one we heard of got killed in the rush to send messages.

* * *

TOMPKINS (Londonderry).—See answer to WILLIAMS (Bristol) given above.

* * *

F. L. (Launceston) and JAMES K. (Ealing).—The only way to receive Eiffel Tower signals is by means of a bedstead. (See Electrical Papers, etc.) We have not yet tested the Charlady or Bucket receiver, but believe it gives good results.

* * *

JONES (Chester).—Full particulars of how to make a wireless birdcage will probably be given at an early date.

* * *

EXPERIMENTER (Liverpool).—You ask us how to make a "loose-coupler." We abhor the term. Why don't you call it a Reciprocally Inductive Oscillatory Current Transformer? It's so much easier to say.

* * *

N. A. (Tobermory).—To find the wavelength of a tubular aerial, firstly, take what you assume to be the approximate wavelength, in feet, multiply by 3π, divide by 3·14159, and you will get the answer in yards. By a simple algebraic calculation this can be reduced to feet or metres.

* * *

ENTHUSIAST (Dundee).—We thank you for forwarding to us your new receiver with which you claim to have received strong signals without either aerial or earth. Since removing a half-dead fly from the telephones we have heard nothing, so we are returning the instrument to you for readjustment.

* * *

G. F. R. (Carnarvon).—No; Noah's Ark was not fitted with the system you mention. We believe they had a difficulty in getting a good earth.

* * *

ENGINEER (Edinburgh).—The principle of the high-frequency alternator is as follows: Firstly, an alternator with a frequency of about 2,000 is constructed. This is coupled up to a steam turbine. The station engineer then sits on the safety valve and speeds up the machine to about 20,000. Condensers are next shunted across any part through which the current is likely to squirt out. Every now and again a current achieves liberty, rushes into the condenser, is disappointed, and has to rush back again. This excites the armature and increases the frequency to about 200,000. The aerial is then connected to any odd terminals across which a condenser has not been shunted, and as a result a violent oscillatory current rushes up and down the aerial. This excites the engineers. Everybody and everything gets excited. The present great disadvantage of these high-frequency machines is that, if the station engineer shifts his position on the safety valve, the frequency alters its value like a mining share. Further, at these high speeds most alternators have rag-time propensities.

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CARTOON OF THE MONTH

The Experiences of an Amateur.

FROM A SUBURBAN CORRESPONDENT

With 20ft. of ordinary copper wire, a garden rake, a bicycle, a few odds and ends valued at 5s. and a pair of telephones, I easily read wireless time signals from Eiffel Tower. My wife and children were greatly interested in my experiments," etc., etc.

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NOTES OF THE MONTH

COMPLETION OF CAPE RACE STATION. STATIC DISTURBANCES. STATIONS AT AMERICAN GULF PORTS. THE LICENSING OF AMATEURS. A NEW POST OFFICE ORDER.

THE re-opening of the Cape Race wireless telegraph station calls for more than passing notice. The geographical position of this Newfoundland coast station renders it of special importance to ships in one of the most dangerous portions of the Atlantic Ocean, and its services as an aid to navigation have made it renowned. It was not without a feeling of dismay that the world received news of its destruction by fire on May 5th. But the Canadian Marconi Company lost no time in setting to work with the object of restoring the service. Immediately after the fire, work was commenced on the erection of a temporary station, and, on permission being obtained from the Department of the Marine and Fisheries of the Canadian Government, the Cape Race Lighthouse engine was belted to the wireless transmitting apparatus, and the temporary installation put in running order. Within three days of the date of the fire a continuous twenty-four hour service was again established, and the station was able to effect communication with all vessels on the Canadian route. In the meantime, new plant was installed in a building of special fireproof construction. This was completed on October 17th, and the station, which has a wave-length of 600 metres and an average daylight range of 500 miles over sea, is now in full operation.

* * *

The development of the great commercial service between the constantly moving ship stations and provision for their increase in numbers has required one of the most carefully devised organisations in the country, and what amounts to practical standardisation of Marconi apparatus. Engineers of long experience are constantly making inspection trips not only aboard the ships, but to all parts of the country where land stations are located. Prominent among the problems that these men have been dealing with is the elimination of the static disturbances which are sometimes encountered. One of the inconsistencies of Nature is to endow a certain locality with all the necessary advantages in geographical position and formation so that it may grow into a flourishing shipping centre and then hamper its operations with adverse atmospheric conditions. A notable instance of this kind was the prevalence of static disturbances in the region of the Gulf Ports. The chief inspector of the American Marconi Company has just returned from a trip through this section, and reports that the effect of these disturbances has now been reduced to a minimum, and they no longer interfere with message transmission. Improvements in the design of apparatus have been responsible for this desirable condition, the importance of which may be best illustrated by a glance at the work in progress at the Gulf ports.

* * *

New Orleans, which few realise is an American port second only in importance to New York, is to have one of the most powerful stations in the country. It is being erected for the United Fruit Company, and forms a link in their service chain located in Swan Island, Santa Marta and San Antonio, Cuba. The stations are located about eight hundred miles apart, and have two 25-kilowatt sets installed, which can be coupled together at times when higher power is needed. The New Orleans station is about completed, and the Swan Island installation will be in operation within a few weeks, when it will become the principal relaying point of the chain, working with San Antonio, Cuba. Communication will also be had with New Orleans, which the static formerly prevented. Santa Marta, the site of the station completing the chain, is an important port for the United Fruit Company, for here are some of the largest

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plantations. Its station is completed and working. On the roof of the Grunewald Hotel, in New Orleans, two 125-foot towers are being erected in place of the small masts formerly employed, and a new and improved set is being installed. This station is perhaps the most important of the Gulf land stations engaged in ship-to-shore traffic, and with its new equipment will not be hampered by static disturbances.

* * *

The Post Office have recently issued a communication to all Post and Telegraph Engineers and Police Authorities, specially dealing with the use of portable wireless apparatus by unauthorised persons. In this order such officials are allowed to ask any such persons as they may see experimenting to produce their credentials, and failing these, they can forbid the further use of the apparatus. As is already known to all interested in wireless telegraphy, no amateur may equip and make use of wireless apparatus without having special authority from the Postmaster-General. The object of the provision was to protect the privacy of messages, and to prevent mischievous interference by irresponsible persons. It was never the intention of the Government to prevent any serious study of the science, but to free serious exponents from any unnecessary interference. At first it was only necessary to advise the Postmaster-General of the intention to erect a wireless station, and to fill in a form giving particulars of such installation, when an inspector would be sent to view the station and a permit for its use would be handed to the owner. Later, the number of applications became so great and entailed so great an increase in departmental work that it was found necessary to institute an initial fee of One Guinea, which was to be forwarded with the application for a private station certificate. But it soon became obvious that no provision had been made for the portable station. It was not to be supposed that anyone using such a station would carry about with him the Postmaster-General's certificate. Nevertheless, it was thought advisable, and rightly so, that there should be some hold of the Government over such persons, for they are equally capable, and perhaps more so, of using the apparatus carelessly and maliciously, and interfering with messages, especially, as might likely happen, if they were within range of manœuvres, and similar official experiments. Therefore, a ticket has been issued, which is to be forwarded to all applicants who, at the time that they register their station, inform the Postmaster-General that they have a portable wireless set and require the necessary permission to use it. They will then receive, not only their Certificate of permission, but this ticket, which they will be expected to carry with them whenever they are making use of their portable set. It is of convenient size, easily enough to slip into the waistcoat pocket, and will ensure the owner free use of the apparatus.

* * *

The reception of the Order referred to in the foregoing Note reveals a considerable amount of public uncertainty as to the Postmaster-General's right to issue regulations. It is well to point out, therefore, that by the Wireless Telegraphy Act of 1904 the Postmaster-General is vested with the control of wireless telegraphy in this country, and no person may establish a wireless station or installation without a license. The license granted, says the Act, shall contain the terms, conditions, and restrictions, and if a person establishes a wireless telegraph station, or installation, or works any apparatus for wireless telegraphy without a license, he shall be deemed guilty of misdemeanour, and be liable on conviction under the Summary Jurisdiction Acts to a penalty not exceeding £10, or, on conviction under indictment, to a fine not exceeding £100, or to imprisonment, with or without hard labour; and in either case to be liable to forfeit the apparatus which has been installed or worked without a license. If there is reason for supposing that a wireless station has been established without a license a search warrant may be obtained, authorising the police to enter and inspect, search, or seize any unauthorised apparatus. Licenses are granted for persons to conduct experiments in wireless telegraphy, subject to special terms, conditions, and restrictions, and the Postmaster-General may grant special licenses, at reduced terms, for the establishment and working of wireless telegraph stations to be used exclusively for the transmission, within the United Kingdom, of news to be published in registered newspapers. The Postmaster-General also has the power to close any wireless station at any time.

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Maritime Wireless Telegraphy

TWO sensational rescues at sea have recently excited public interest. The one was that of the Johnston liner *Templemore*, which was abandoned on fire in mid-Atlantic, and the other was of the steamer *Spokane*, which was wrecked off Cape Lazo, and would have been a total loss but for the use she made of her wireless.

The *Templemore* was on a passage from Baltimore to Liverpool. She was one of Messrs. Johnston's largest liners, and was

Mr. R. Emanuel Operator on the "Templemore"

regularly engaged in trade between these two ports. She sailed from the Mersey on September 6th, and arrived at Baltimore on September 17th. After a stay of ten days at the latter port, discharging her Liverpool cargo and loading a full cargo of United States produce, she sailed from Baltimore on Saturday, September 27th, for Liverpool. On Monday evening a wireless message was received in Baltimore from the *Templemore*, stating that she was on fire in lat. 39·27 N., long. 65·27 W., and requiring immediate assistance. All the steamers in the vicinity were quickly communicated with by wireless, and early on Tuesday morning the Hamburg-America liner *Arcadia*, on a passage from Hamburg to Baltimore, reached the *Templemore*, and took off the whole of the crew who were taken on to Baltimore.

Thus again has the value of wireless telegraphy been demonstrated, for had the *Templemore* not been equipped, it is possible that she would have been completely destroyed, and the danger of the crew accentuated before assistance arrived on the scene. As it is, immediately the fire was discovered to have broken out on board wireless communication was effected with the shore stations, and in this way news of the disaster was telegraphed to Liverpool, together with the information that the whole of the crew had been rescued, while the steamers which happened to be in the vicinity were apprised of the casualty, and were given the position of the *Templemore*, and requested to hurry to the spot in order to render assistance.

The *Templemore* was under the command of Captain Isaac Jones, who had been in charge of the vessel since 1910, and she carried a crew of 54 men all told. The position at which the vessel was abandoned is about 520 miles from Cape Henry. The *Templemore* was a steel screw four-masted steamer of 6,344 tons gross and 5,156 tons net, built in 1894 by Messrs. Harland and Wolff, of Belfast, and classed 100 A1 at Lloyd's. Her dimensions were 451 feet by 48 feet 3 inches by 26 feet 8 in., and she was owned by the Templemore Steamship Co., Ltd., Messrs. Wm. Johnston & Co., 18 Water Street, Liverpool.

According to Captain Jones the fire was started by spontaneous combustion in some bales of cotton amidships, and the smoke was first seen at 11.50 on Monday night. Twenty minutes later the wireless operator, Raphael Emanuel, flashed out the first signal of distress, which was picked up by the operator of the *Arcadia*, fifty-two miles away. Efforts to put out the blaze were soon abandoned, and the crew began taking to the boats. The fire quickly destroyed the dynamo operating the wire-

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less apparatus, but, with the aid of candle-light, Emanuel got his reserve storage batteries working, and for another fifteen minutes continued to tell the *Arcadia* the exact position of the burning ship.

"My men appeared to be unmindful of the danger," said Captain Jones, "and fought the blaze until it was foolhardy to continue. Emanuel stuck to his post until the storage batteries refused to work, and he and I were the last to leave the doomed vessel. No man left the ship until he received instructions from me.

"Our experience in three small boats was the worst of all. A storm was raging, and the wind nearly upset our slender craft. By three a.m. on Tuesday, when the *Arcadia* arrived, many of the crew were sea sick and exhausted. Some were so weak that they had to be lifted out of the boats. When the *Arcadia* started towards Baltimore the *Templemore* was aflame from bow to stern."

* * *

The United States steamer *Spokane* was wrecked off Cape Lazo, on the Vancouver Coast, on Friday, September 27th. Immediately the disaster occurred she sent out a wireless message, calling for assistance and urging vessels to rush to her rescue, as she was sinking fast. Her message was immediately responded to by the *Latouche*, with the result that the passengers and crew were all taken off in safety, and not only that, but the *Spokane* herself was found to be capable of refloating, and after this was effected she proceeded for Seattle under her own steam. The *Spokane* is a well-known passenger vessel belonging to the Pacific Coast Steamship Company. She was built in 1901, and is of 2,036 tons burden. Her cargo was valued at £41,000.

* * *

This story of the saving of both life and a valuable cargo by means of wireless is in striking contrast to the story of the loss of the *Gardenia*, which was reported at the same time. The *Gardenia* was a valuable vessel of 1,800 tons burden, and was fully laden with a cargo of copper ore, of about 2,800 tons, and this, if the price of copper ore be taken at only £36, or one half the current price of pure copper, represents a value of over £100,000. As the *Gardenia* was making its way across the North Sea for Middlesbrough she came into collision during a fog with the London collier steamer *Cornwood*. On hearing the approach of a steamer, the Captain of the *Gardenia* stood off the Middle Cross Sands and sounded his syren, but the oncoming vessel struck the *Gardenia* on the starboard side, cutting five or six feet into the depth. She sank in four minutes, carrying down with her every soul on board, and of these only four were rescued—the master, one of the engineers, and two of the crew, so that eighteen lives were lost in the disaster.

Neither of the vessels was fitted with wireless, and all they could do was to attract the attention of any passing vessel by whistles. It happened that the *Valoris* of Banff was passing near and was able to save the four men. But it is possible that had a wireless call been sent out the loss of life need not have been so heavy.

* * *

While carrying out manœuvres in the North Sea, the new destroyer *Jackal* came into violent collision with the Super-Dreadnought *Thunderer*. Great damage was done to the destroyer's bow, which was holed above and below the water-line. She made water rapidly, and the situation was so serious that a wireless message was sent to Dundee, the submarine base, for all available help. Two battleships and two tugs set off to the assistance of the disabled vessel, which they found with her bows almost under water, her bulkheads serving to keep her afloat. The rescuers took the *Jackal* in tow, and the perilous voyage was successfully made.

* * *

Last month, the Dutch steamer *Willis* ran aground near Calella on the Spanish Mediterranean coast. As soon as the accident occurred the captain of the vessel reported the matter to the Marconi station at Prat de Llobregat (Barcelona), which transmitted the message to the Dutch Consul in Mataro, and, the naval authorities also having been informed, they sent out the tugs *Catalana* and *Monserrat* with life-saving apparatus of every description on board. During this time the Prat de Llobregat station kept up continuous communication with the *Willis*, and was informed that the position of the ship was not considered such as to endanger the lives of the passengers or crew.

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Administrative Notes

Newfoundland.

THE "Marconi Wireless Act, 1913" (No. 24 of 1913) which has just been issued, confirms an Agreement entered into on April 20th, 1912, between the Government of Newfoundland and the Marconi Wireless Telegraph Company of Canada, Ltd., and at the same time provides that all instruments, apparatus, supplies and stationery required and used by the Company in installing, maintaining and operating various wireless telegraph stations in Newfoundland and Labrador shall be admitted into the Colony free of duty during the term of the Agreement, viz., until April 6th, 1926. It is, however, provided that this exemption shall not be held to include provisions or household goods, furniture or supplies of any kind for the personal use of any of the Company's employees.

* * *

Gold Coast Regulations.

A BILL has been proposed which provides for the regulation of wireless telegraphy in the Gold Coast colony. The object of the Bill is to define more clearly the requirements as to the use of telegraphy by ships, and to codify the law and make it uniform with the Ordinances of other West African colonies. By section 3 of the Bill it is provided that only with regard to ships registered in the Colony is it necessary to obtain a licence before installing wireless apparatus on board them. But, by section 4, it is required that all merchant ships, whether British or foreign, shall, while in the Colonial waters, work their apparatus in accordance with the prescribed regulations. It is proposed to repeal the Wireless Telegraphy Ordinances of 1903 and 1913.

* * *

The United States & the Convention.

THE Minister of Marine of the United States of America has notified to the Berne Bureau that the following information is to be published:

1. The Departments of the United States Government which are concerned with wireless telegraphy regret that they have not yet been able to make arrangements with the land telegraph of the United States owing to the fact that these are in the hands of commercial companies, and have nothing to do with the Government. The idea was to arrange for the free transmission over the land telegraph, in accordance with Article 14, paragraph 2, of the Rules of Service of the London Convention. The information to be transmitted free of charge was all such as related to the date and the hour of the handing in of radio-telegrams on board ship. But the transmission of such information over land lines being subject to a tax, the Government of the United States cannot, at present, conform strictly to this rule of the Convention. The declaration of the American delegation contained in Article 2 of the Final Protocol made provision for such a possible outcome, although its exact nature was not actually set forth.

2. Multiple radio-telegrams, such as are mentioned in Article 38, paragraph 5, of the Rules of Service, will be accepted as multiple messages in all wireless transmission between ship and shore stations, but all the companies operating land telegraph lines in the United States will consider, and will charge for a multiple wireless message as consisting of so many individual telegrams, as the addresses it bears may indicate.

3. The United States is not a member of the International Telegraphic Union, and consequently is not bound to execute the rules laid down in Article 38, paragraph 8, of the London Convention Rules of Service concerning urgent radio-telegrams. The laws of the United States regulating all reciprocal arrangements between the States forbid the use of the privilege, and consequently all telegraph companies will not allow any priority in favour of telegrams for which an additional tax may have been paid.

* * *

MAKING use of the faculties allowed in Article 16, paragraph 1, of the Radio-telegraphic Rules, the American Administration has authorised certain shore stations to charge any taxes above the maximum of 60 centimes.

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Contract News

La Société Anonyme de Telegraphie sans Fil have received orders to equip three cargo vessels, the *Zaire*, the *Bolama* and the *Ambaca*, with half-kilowatt and emergency gear. They are also installing a 1½ kilowatt set for a whaling factory at Hull.

* * *

The Compañia Nacional de Telegrafia Sin Hilos have received orders to equip two battleships for the Spanish Government, one with a 15 kw. set, the other with a 5 kw. set. They are also erecting a 1½ kw. set for the *Escuela de Applicacion*.

* * *

The Marconi Wireless Telegraph Company of Canada are installing ½ kw. sets on the steamers *Montcalm*, *Lady Grey*, *Druid* and *Simcoe* for the Canadian Government. They are also fitting wireless on the lightship *Lurcher*, while the *Princess Maquinna*, a steamship engaged on West Coast service in connection with the Canadian Pacific Railway, which has recently been fitted with a 1½ kw. installation, has been allotted the call letters V G T.

* * *

The Royal Mail Steam Packet Company are having their liner, the *Pembrokeshire*, fitted with a 1½ kw. Marconi set.

* * *

The Spanish Government have purchased another 5 kw. and emergency set from the Compañia Nacional de Telegrafia Sin Hilos.

* * *

A ½ kw. and emergency set has been purchased from Marconi's Wireless Telegraph Company by Mr. M. Fitzgerald, who intends using it for instructional purposes.

The following Vessels have been equipped with Marconi Apparatus since the last issue of the *Wireless World*.

Name.	Owners.	Installation.	Call Letters.
Swanmore	Johnston Line	1½ kw. and emergency	MAE
San Dunstano	Eagle Oil Transport Co.	,,	MAN
San Tirso	,, ,, ,, ...	,,	MAO
San Urbano	,, ,, ,, ...	,,	MCC
Invertay	Law, Leslie & Co.	,,	MAT
Botanist	Harrison Line	,,	MAP
Musician	,, ,, ...	,,	MAD
Ludwig Weiner	Union of South Africa	,,	—
Snaefell	Isle of Man Steam Packet Co.	,,	MCS
Ulysses	Alfred Holt & Co.	,,	GBU
Maryland	Atlantic Transport Line	,,	MBW
Llandovery Castle	Union Castle Steamship Co.	,,	MCO
Desabla	Andrew Weir & Co.	,,	GYV
Toronto	Wilson Line	,,	GBS
Salmo	,, ,, ...	,,	GYI
Charles E. Harwood	Petroleum Carriers, Ltd.	½ kw. and emergency	GYU
Brighton	L.B. & S.C. Railway	,,	MOV
Dieppe	,, ,, ,, ...	,,	MRL
Den of Airlie	Charles Barrie & Sons	,,	GBK
Cyclops	John Fullerton & Co.	,,	—
Matoppo	Bucknall Steamship Line	,,	MAM
Kasama	,, ,, ...	,,	GBP
Bloemfontein	,, ,, ...	,,	GBN

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire. His most recent invention is an airship worked by wireless, which is likely to revolutionise aerial warfare. Negotiations are proceeding with the War Office for its purchase from the inventor.*

GWEN THRALE.—*Charles Summers' fiancée, a bright, intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society. She coaxes Summers to teach her "wireless," and soon becomes a proficient operator and a bit of an engineer.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip. They are discovered and "tapped" by——*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly they belong to the leisured and wealthy class; but in reality they are secret agents for a foreign Government sent over to England for the purpose of securing military or naval secrets. Their attention is directed to Summers' work, and they determine to get possession of the airship's plans.*

CHAPTER VII. (*contd.*).

APPARENTLY the person in question was walking away, for she slightly shifted her position as if she were anxious to obtain a last glimpse; then, she suddenly made up her mind to speak to this acquaintance, for she reached out quickly for her gloves, put down the money for her bill, and with a swiftness which caused even the sleepy-eyed attendant to wonder, passed downstairs and out into the street.

She did not wait to fetch her dog or to take her carriage. She walked quickly along the pavement in a desperate effort to catch her friend up, but he seemed to be unaware of her presence. He simply stopped to post a packet in the pillar-box just outside Westminster Cathedral, and then he made his way to Victoria Station. He had not much time to spare, for as he hurried along he looked at his watch. It was nearly two o'clock. He broke into a brisk trot, which left his follower far behind; but, for her part, the race had already lost its interest and she gave it up. Summers had disposed of his postal packet, and this was all she cared about. By a strange coincidence, however, his action of posting his long blue envelope had reminded her that she too had a letter to post, for she immediately produced one from her reticule and put it in the box. First of all she looked to see when the next post was collected. The little tin plate indicated 2.15. She seemed to have no time to lose, for she hurriedly beckoned her carriage, and without remembering to take her dog, drove away. Her coachman took her down some side streets which led out into Victoria Road. There she found the little horsey man waiting her as if by appointment, for the carriage stopped immediately, and he took his place beside her. They held a short but earnest conversation, the result of which was that the man went back again to the A.B.C. and the woman disappeared into one of the unprepossessing looking houses which are the outstanding feature of this *démodé* thoroughfare. Scarcely a quarter of an hour had elapsed before out of the same house came a neatly-dressed young lady in coat and skirt, with high brown boots and a general businesslike air. She bustled along with short, quick steps which would have been long had it not been for the narrow walking skirt. She, too, carried a reticule, and also a brief envelope containing what must have been a bundle of papers, for it

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looked fat and heavy. Quickly she made her way through the side streets to Westminster Cathedral, and then crossing the road went to the same pillar-box that Summers had previously visited. In it she thrust her envelope, but the package was almost too large for the aperture and she had to crush and squash it. It seemed to give way suddenly, as though something had broken within it, and when at last she succeeded in squeezing it into the box she ruefully looked at her gloves, which bore great corrosive stains. Hurriedly she took them off, stuck them in her hand bag, and walked away. It was well she did so, for a sickly smell attracted the attention of the passers-by to a dark fluid which issued from the bottom of the box, and spread in a thick stream over the pavement. An enterprising messenger boy ran up to the nearest policeman, who seized his note-book and made various hieroglyphics therein. Then he told the boy to call his colleague of the neighbouring beat, and by-and-bye the second custodian of the law appeared. By this time quite a little crowd had collected, and word was passed between them with a flutter of excitement that suffragettes had been at their pranks again. One of the most interested of the onlookers was the short horsey man, who seemed only too glad of this mild excitement to while away an idle half hour. He waited till the postman came up, and the letters were collected. He was so curious that he forced his way through the street urchins, who had managed to get in front of everybody else, and watched operations so closely that he positively hung over the postman's shoulder until one of the policemen motioned him back, and told him not to get so near. This seemed to disgust him, for he walked away in a surly mood. Still his ill-humour did not last long, for by the time he had reached Victoria Road he was all smiles. Eventually he entered the house inhabited by the young suffragette who had returned only a few minutes before. He must have been another member of this strange household, for he used a latch key, and slamming the door behind him, he quickly made his way up the narrow, creaky stairs, where the well-worn linoleum did little to diminish the sound of his quick footsteps and the gaudily papered walls only emphasised his unequal breathing. Without any preliminary he made his way into the bedroom, and there he found the young lady of the walking costume. But it was a curious spectacle which met his eyes. The young lady was undressing. She had already divested herself of her outer garments, and was standing in her high-heeled boots with brown stockings, short white pants, corsets, and an untidy mass of short fair hair. She was busy at the looking-glass trying to affix on her upper lip a fair moustache, and when she saw Dupont she gave a loud, manly laugh.

"I'm thankful to get off these beastly things," she groaned, as she proceeded to squeeze herself in to undo the stay busks, and then with an exclamation at their discomfort she tossed them on to the bed.

"Eh, *mein freund*, think you not I make a most excellent fraulein? A fraulein suffragette? But we must get rid of this property. There's no knowing who may have seen us come in here. I think the best thing is a bonfire. You've got some turpentine. Don't you think we had better set to and destroy them now?"

"*Non, non*," said Dupont, "*Nous ne sommes pas encore échappé le bois.* We must to the Post Office to claim our poor spoilt letter. We must not let the war devils take it from us. Let us go now, now at once, for we can say that we have heard how much the letters are spoilt. They will believe us, and it is best that they should not have time to think at all about it. We must get it this evening, for if we don't, then we shall have a thousand and one questions to answer, and papers, papers, papers to sign, and silly old gentlemen to see. So, come along, change as quickly as you can into the English gentleman and I will get rid of these ugly clothes and make myself somebody else."

With these words Dupont pulled a trunk from under the bed, and hauling off his queer garments he changed himself into a most curious specimen of the learned class. Imagine a professor with something of a stoop, a straggly beard, thick gold rim glasses, a shabby Inverness, and an equally shabby green hard felt hat, and you will have a fair idea of Dupont in his latest disguise. But when he put on a pair of very weatherworn and ill-fitting gloves and tucked an equally weatherworn walking stick under his arm, he looked the part of a seedy professor to perfection.

Negotiations with the Post Office were a matter of some difficulty. One thing was certain, however—the letter was sufficiently

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damaged for the address to be undecipherable. Dupont had made himself certain as to this when he leaned over the postman who had collected the letters. Nevertheless, there was no knowing what questions might be asked by the authorities, and although Dupont might be able to answer all the chief facts of the case, there were many minor points and details, which, if they were unlucky, might prove their downfall. Moreover, Dupont, on account of his unsatisfactory English, was obliged to leave the matter entirely in Beulner's hands. The German was a very good accomplice, but he had not the clear wit of the Frenchman, and was more easily thrown off his guard. Speed in this case was everything, and therefore when a sufficient time had elapsed to make it probable that the damaged post-bag would be in the hands of the chief authorities, Beulner and Dupont made their way to King Edward Street. Beulner had been well coached up in the part he was about to play, and he and Dupont hurried into the building. As chief spokesman, and presumably an Englishman, he was dressed something after Summers's style —grey suit, a grey squash hat, and a bundle of papers in his hand, besides a bulky pocket-book in his dress pocket. The elaborate Frenchman was not to be recognised in the transformed Dupont. He had assumed a droop of the shoulders which made him look inches shorter and this effect was accentuated by his shabby Inverness cape, and it would have required a very astute observer to have penetrated his disguise. The two men invaded the Central Post Office, showing all the signs of suppressed excitement. They asked to see the official who looked after the damaged correspondence. A red-coated commissionaire invited them into the interior of the vast building, and they were taken along corridors, up lifts, and through various ways to the apartments where a morose-looking, sleepy gentleman was busy at a huge mahogany desk, looking over varieties of papers done up in bundles with the usual red tape embellishment. Beulner immediately explained the object of their visit. He spoke volubly and quickly, really much too quickly for his hearer, whose mental activity had long since been lulled to repose by the quiet of office, and who had to exert his intelligence in a most unwonted degree in order to make out their purpose. As to the excitement of these strangers, he put it down to their anxiety for the safety of their document. Beulner explained to him that he had only just posted his letter when the outrage had occurred, so that it had inevitably been damaged. It was a most important affair. There must be no delay, and he had promised the War Office to bring them the document as soon as it was recovered. Therefore he would be glad of the officials' assistance in the matter. Could he manage to get hold of the letter? It was written on a similar paper to this, and here Beulner produced the specimens taken by Dupont from Charles's den. In an off-hand way Beulner added the general import of the missive and an outlined description of the airship. Now and then he turned to Dupont for corroboration of his statements, and it is needless to say that the "scientist" supported him in everything. For some time the official was disinclined to take any steps in the matter. The letter, he explained, would be returned in due course as damaged, but Beulner pointed out that this was a particular letter of great importance and a Government document. He offered to ring up the authorities to support his case, and mentioned names high up in Parliament, hinting that if the matter could not be cleared up now he would approach the Postmaster-General through his friend, "——," and here he named a Cabinet Minister. This had an effect on the staid servant of the Post Office. He was not anxious to have his name mixed up in an affair of discourtesy. He saw vistas of a long and unpleasant inquiry when he would be bothered to distraction, and his orderly soul revolted against such a strain, so that in the end he took the path of least resistance and summoned an attendant.

"Was Mr. So-and-So in?"

He was.

"Could he see him for a moment?"

The answer came back that he could, and the three men paraded through further corridors to another similar in orderly detail to the one they had just left, where sat in state a benign and courteous personage, with hands carefully manicured, and his fair hair smoothed carefully over his high head in a skilful effort to conceal a premature

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baldness. He listened to the evidence of his subordinate, and then meditated a considerable time, rising and pacing the room with his hands neatly folded behind his back. Now and then he looked down into the courtyard below, and seemed to study intently the coming and going of the Post Office vans. Once or twice he put forward a question not very difficult to answer, but sufficient to keep Dupont and Beulner on the rack of excitement. But now the hour of tea was approaching. He noted this by the watch on his wrist, and the fact urged him to decisive action. He ordered the post bag in question to be brought in to him. Another subordinate was called in to witness the cutting of the seals, and finally the letters were spread out on the broad table. The damage was fairly extensive. Many of them had their envelopes practically destroyed by the corrosive fluid. The long blue envelope which Beulner and Dupont instantaneously spotted and remarked upon was eaten almost in two by the chemicals. Still, when it was opened there was not much damage found to have reached the document itself. One or two holes in places, and one stream across the front page, that was all. The rest of it was easily decipherable. After satisfying himself as to its contents, and verifying the letter accompanying it with the notepaper Beulner had handed him, the official passed it to the claimants. These were asked to sign a receipt for its delivery to themselves in person, a request which they immediately and willingly complied with. Then with a word of thanks the two were ushered out by an attendant, and made their way once more through the intricacies of corridors till they at last found themselves in the street. The success of their mission now practically assured, the two accomplices felt a keen desire to execute a triumphant war dance then and there, but neither dared so much as breathe freely, lest their action might arouse even passing comment. Instead they walked quickly to Newgate Street, where they hailed a taxi and drove to Charing Cross Station. Arrived there, they claimed some luggage from the booking office, and, brandishing Cook's Tourists' tickets, took the five o'clock train for Boulogne. Their work was over. They had secured a document of infinite price to their Government, and they were not likely to return to wander up and down Victoria Street or rusticate in Sotheby again, at least not as Monsieur Dupont and Herr Beulner.

CHAPTER VIII.

On the Horns of a Dilemma.

Charles was all this time blissfully unconscious of these happenings. His few days' holiday were not disturbed by cares of any kind. He was one of those fortunate individuals who, as soon as he had finished his business, could throw off his preoccupation and enter whole-heartedly into his pleasures. It was only on his return to Sotheby that he received the first intimation that all was not well. Awaiting him was an official-looking document from the Post Office. In it he was informed that his specification was awaited with anxiety, and that Lord —— would be glad if he could forward it at his earliest convenience. Immediately Charles replied, stating that the document they referred to had been posted several days before, and he would be glad if they would make inquiries as to its reception or not. On this a reply came back that the letter had never been received, and inquiries were being instituted at the Post Office. Needless to say, by this time Charles was greatly perturbed. The Dupont incident had rankled in his mind, and he felt that the present delay was not entirely due to accident. There was no reason why the letter should not be found before long, but the question was—where was it at the present moment? Charles thought to himself that these foreigners could possibly answer this question, but as it was impossible to get at them, he determined to acquaint the authorities with his suspicions. Forthwith he journeyed to the War Office, and his card was sufficient to gain him an interview with the Under-Secretary. The Under-Secretary was a keen, intellectual, hard-mouthed man, one who was not likely to let things slip. As soon as Charles had explained the object of his visit, he rang a small electric bell, and an attendant appeared. He might have been an aide-de-camp. Young, well built, fair haired, with striking black eyes, smooth skin, dark eyebrows, and a little dark moustache over weak but full-blooded lips, he, too, was

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certainly alert and intelligent, for in a twinkling his lively glance had taken thorough stock of Charles from the tip of that worthy's travel-stained boots to his unkempt locks. But he betrayed by no sign that he had even observed the visitor, only showing a soldierly obedience to his superior and waiting for his instructions with as much immobility as any sergeant to any colonel.

"Braithwaite," said Sir Henry Dever, "this gentleman is making inquiries with regard to a specification which he posted here more than a week ago. Let me see"—and here he interrogated Charles—"July the twenty-third, wasn't it, to be exact?" It seems that the letter has gone astray. Make inquiries at the Post Office."

"By the way," he said, turning to Charles, "can you tell me where you posted it? It might be of help to the officials."

"Yes," said Summers, "it was at that post office nearly opposite Westminster Cathedral, at the turning down Victoria Street, and the time I posted it was about one o'clock, for I caught the one-thirty to Louth."

"Sir," said Braithwaite, "if I remember rightly, that was one of the pillar boxes raided by the suffragettes. There was a report in the paper of it which I remember to have read."

"Are you sure?" said Sir Henry, interrupting him.

"Yes, Sir Henry, I am practically certain, but I will verify my statement if you wish."

"You had better make absolutely sure before we get any further. Come back again as quickly as possible. This matter has got to be settled at once."

Braithwaite retired, and Sir Henry turned to Summers. "If you don't mind waiting I think it would be best for you to stay here till Braithwaite returns. He won't be very long; but it looks to me as though this business will take a lot of clearing up. It's odd, if what my assistant says is true, that the very post box in which you posted your letter should have been attacked."

With that he turned to some correspondence at his elbow, and Summers was left to while away the long tedium as best he could. When the young subordinate reappeared he brought no very definite news. What he had previously intimated was true—the pillar box had been tampered with, presumably by a suffragette—a woman, at all events—who had dropped some corrosive fluid through the opening. The police had been warned almost directly the incident had taken place, and a special postman had been dispatched to take charge of the letters. He had been told that these letters were sent straight to the authorities at the post office, and he had made inquiries there. He had found out that most of the letters had been forwarded to the respective consignees, a few had been too badly damaged to be decipherable, and one or two had been called for. A search through the remaining letters showed no such document as Summers had described, but the head of the department had informed him that on the afternoon of the outrage two men had called, and taken away such an envelope as was wanted. He had been shown the receipt for it, which gave the address of the consignee as Sotheby Vicarage, and according to this receipt it had been handed over to the writer himself—Charles Summers. Ownership, so the official had assured him in reply to his inquiries, had been established, not only by private cards, but by specimens of the paper used and by the seal used for the letter. Furthermore, the recipients had given an accurate and general detailed account of the subject of the specification. Charles leaned back with a low whistle.

"The deuce!" he exclaimed. "There's no doubt about it. That's my letter. Those foreigners have got hold of it. They must have watched me all the time. I expect by now they are out of England. Here's a pretty kettle of fish."

CHAPTER IX.

A STRATEGIC MOVE.

Dumbfounded though he was by the discovery, Charles could not realise how great the loss was that he had suffered. As a matter of fact, his temperament was such that the whole force of the circumstances and their consequences would never strike home to him. He was one of those philosophical and impracticable people who are always living in a world outside everyday circumstances, building phantom cities and constructing great engineering feats with only dreams for substance from plans mapped only in the imagination.

(*To be continued.*)

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INSTRUCTION IN WIRELESS TELEGRAPHY

Wireless Telegraph Receivers

(Seventh Article.)

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appeared on page 461 of the October number].

THE word receiver is usually applied to that part of the apparatus of a wireless telegraph station by means of which the electric waves which are picked up by the aerial are sorted out and converted into some audible or visible sign.

The aerial, however, is just as much a part of the receiver as it is a part of the transmitter, and must be in tune with the waves it is receiving, just as the transmitting aerial must be in tune with the waves it is radiating.

We have just said that the aerial "picks up" the electric waves, but this is not strictly accurate. When electric waves travelling through the ether pass across a conductor, they produce oscillatory currents in that conductor, and these oscillatory currents will have the same frequency as the waves which produce them.

By means of an aerial wire, therefore, we can convert the electric waves which are being radiated from a transmitting station into oscillatory currents, and we have only to detect the presence of these currents to enable us to "read" the message which is being transmitted.

51. **Essentials of a Receiver.**—We have already explained that an aerial forms an "open" oscillating circuit and has a natural time period of its own. We have also shown that an oscillatory current will not flow easily in a circuit unless the natural time period of that circuit is the same as that of the oscillatory current—that is to say, in this case the aerial circuit must be in tune with the wave which is to be received.

The first essential of a receiver, therefore, is a variable inductance and a variable condenser, which can be connected in series with the aerial by means of which the latter can be tuned to the desired wave-length.

Fig. 1 illustrates these connections where A and E are the aerial and earth terminals of the receiver, I the inductance, more or less of which can be included in the aerial circuit, by means of the switch, S_1, and C the variable condenser across which is fitted a short circuiting switch, S_2.

The inductance, I, is called the **"Aerial tuning inductance,"** and the condenser, C, the **"Aerial tuning condenser."**

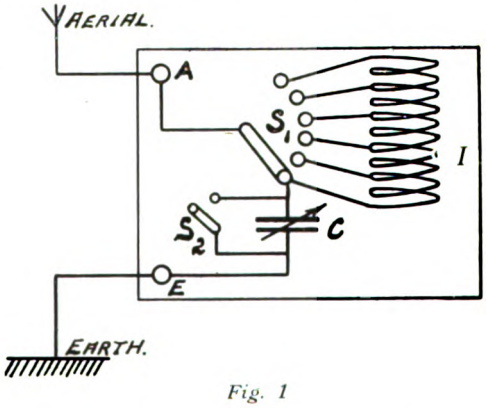

Fig. 1

We know that by placing a condenser in series with the aerial we reduce the wave-length of the aerial, and by placing an inductance in series with the aerial we increase the wave-length of the aerial. If, therefore, the wave-length which it is required to receive is shorter than the natural or "fundamental" wave-length of the aerial, we must cut out all the inductance in the circuit by means of the switch, S_1, and we must reduce

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the value of the adjustable condenser, C, until the correct wave-length is obtained. The switch, S_2, will in this case be open, as shown in the diagram (Fig. 1).

If, on the other hand, the wave-length which it is desired to receive is longer than the fundamental wave-length of the aerial, in order to bring the wave-length of the aerial into tune, we must first short circuit the condenser, C, by means of the switch, S_2, thus leaving no capacity in series with the aerial, and we must increase the inductance in the circuit by means of the switch, S_1, until the correct wave-length is obtained.

The next essential of the receiver is some device whereby the presence of the oscillatory current can be detected.

52. **Methods of Detecting the Oscillatory Currents.**—In the article which appeared in the October number of THE WIRELESS WORLD we showed how this could be done, in the case of a wave-meter, by placing across the condenser of the oscillatory circuit a pair of telephones in series with a crystal. The telephones in series with a crystal constitute a detector. This method can be adopted in the receiver by placing the detector across the aerial tuning condenser, but it is not an efficient method for the following reason.

The aerial tuning condenser forms only a part of the capacity of the whole aerial circuit, so that although the detector may be extremely sensitive it is not being used to the best advantage.

Another method is to apply the detector across the aerial tuning inductance, but this method has also the same disadvantage—viz., that we are only applying the detector to a portion of the whole inductance of the aerial circuit.

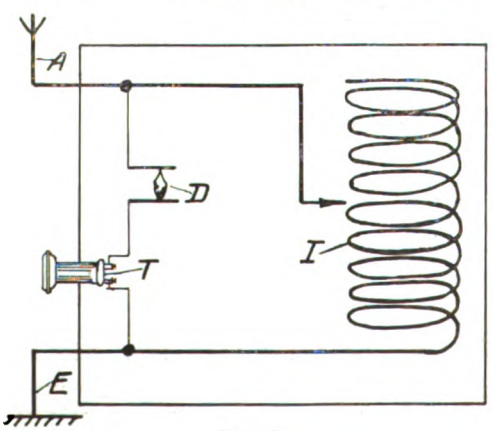

Fig. 2

If, however, we are receiving a wave very much longer than the natural wave-length of the aerial, in order to tune up the latter we naturally have to use a large amount of inductance, and if this inductance forms (as it may easily do) the greater part of the inductance of the whole aerial circuit we may quite efficiently apply the detector across the inductance. This makes one of the simplest and cheapest forms of wireless telegraph receivers and is shown diagrammatically in Fig. 2, where A is the aerial, I the variable tuning inductance, E the earth, D the crystal, and T the telephones.

Most of the amateur stations, more especially those in towns, have very small aerials for obvious reasons, and as they are chiefly used for " picking up " signals from stations using long wave-lengths, this form of receiver is particularly appropriate. With such short aerials even the waves transmitted from ship stations are sufficiently long to necessitate the use of a comparatively large inductance in series with the aerial, so that the receiver may also be used fairly efficiently for receiving signals from ships.

53. **Use of the Battery and Potentiometer.**—Some crystals, such as carborundum, become more sensitive to minute currents when a slight initial voltage is applied across them. This voltage must be regulated exactly to suit the particular crystal which is being used, and this regulation is accomplished by means of a potentiometer.

A potentiometer, shown in Fig. 3, consists of a resistance coil, R, connected across a battery, Q, and provided with a sliding contact, S, by means of which a lead can be connected to any point along the resistance.

The resistance of the coil should be kept sufficiently high, so that the current passing through it from the battery is not sufficient to discharge the battery rapidly. Too high a resistance becomes impracticable, as either the resistance wire with which the coil is wound would have to be so fine that it would easily become broken or cut, or the resistance coil would have to be of such a length that it would not be convenient on account of its size. In practice suitable resistance coils can be wound having a resistance of about 200 ohms, and this connected across a

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battery of 4 volts will only allow about $\frac{1}{50}$th of an ampère to pass through it, so that a battery consisting of three Q size dry cells would be sufficient to maintain its voltage for many weeks with continuous working.

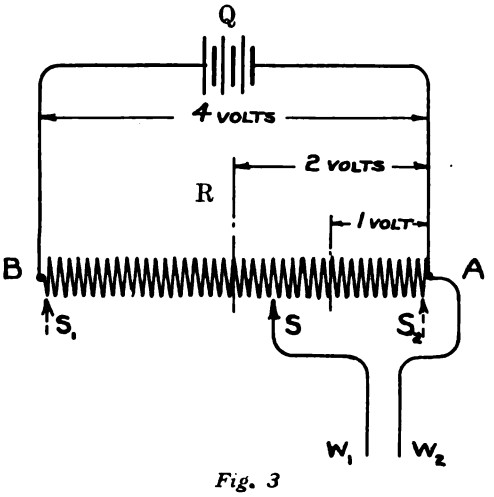

Fig. 3

On referring to the diagram (Fig. 3), and assuming that the voltage of the battery is 4 volts, we have a difference in potential between the two ends of the resistance coil, A and B, of 4 volts; therefore, if we connect a wire, W_1, to A, and another wire, W_2, to the sliding contact, S, and move the latter to the far end of the coil shown in dotted lines and marked S_1, the voltage between the two wires will be 4 volts. If, however, we slide the contact nearer towards the end of the coil marked A, the voltage between the two wires diminishes until the voltage becomes zero, when the slider occupies the position S_2. It is obvious that the voltage across the two wires will be in proportion to the distance the sliding contact is from the point A, and that by moving the slider to any point between the two extreme ends of the resistance we can regulate the voltage between the two wires to any intermediate value between 0 and 4 volts.

With most carborundum crystals the voltage which should be applied across them to bring them to their most sensitive state is somewhere between $2\frac{1}{2}$ and $3\frac{1}{2}$ volts, so that by applying this potentiometer to our crystal we have a simple means of bringing the latter to its most sensitive state.

54.—**Method of Applying the Potentiometer to the Crystal.**—The method of applying the voltage obtained from the potentiometer to the crystal is not as straightforward as it might at first appear to be. The most obvious way of doing it is shown in Fig. 4, where the two wires from the potentiometer are connected one to either side of the crystal. But it will be immediately seen that this entirely neutralises the value of our crystal as a rectifier, for the oscillatory currents, instead of trying to pass through the crystal to the telephones, thus becoming rectified into uni-directional currents, will pass through the resistance of the potentiometer to the telephones.

It is obvious, therefore, that we must devise some means of applying the voltage to the crystal without making a bye-pass for the oscillatory currents induced in the inductance coil.

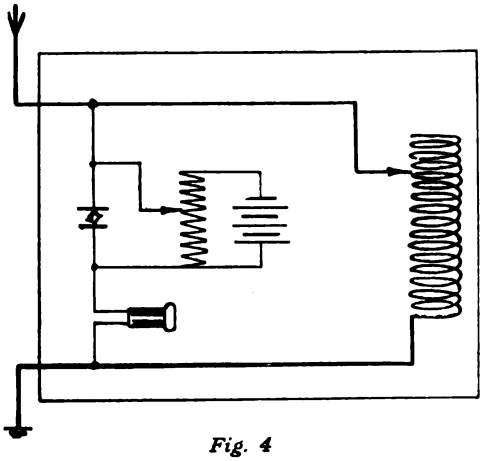

Fig. 4

This can be accomplished by connecting up the circuit as shown in Fig. 5, where the junction of the battery and the resistance coil is connected to the earth side of the crystal. One side of the telephones is then connected to the earth terminal, and the other side to the sliding contact of the potentiometer.

Assuming that the common junction of the battery, resistance coil and crystal, J, Fig. 5, is the negative side of the battery, the sliding contact, S, is the positive, and this positive E.M.F. is conducted to the other side of the crystal through the telephones and through the aerial inductance, as indicated by the arrows.

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Thus it will be seen that we have accomplished what we desired—*i.e.*, to apply an adjustable voltage across the crystal without forming any short cut for the oscillatory currents, which must therefore pass through the crystal and there be rectified before they reach the telephones.

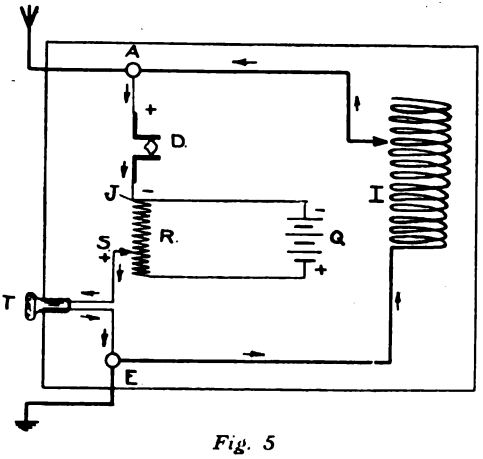

Fig. 5

55. **The Two-Circuit Receiver.** — As already explained, the single circuit receiver just described is quite efficient for stations that are receiving comparatively long wave-lengths on short aerials, but it would be obviously useless for stations which might be required to receive messages on wave-lengths as short or shorter than the fundamental wave-length of the aerial.

If we can cause all the energy in our aerial circuit to be transferred to a secondary circuit and apply our detector across the whole of the inductance or capacity of this secondary circuit, it is obvious that the size of the aerial will not limit us as to the value of the wave-length for which such a receiver can be efficiently used.

56. **The Primary and Secondary Circuits.** —Such a receiver will have two distinct oscillating circuits, both of which must be in tune with the wave-length which it is desired to receive. These two circuits are called respectively the primary circuit and the secondary circuit.

The primary circuit will consist of an aerial, an adjustable inductance, and an adjustable condenser for tuning up the circuit, and a primary coil, by means of which the oscillations can be induced into the secondary circuit, thus transferring the energy from the primary to the secondary circuit.

The secondary circuit will consist of an inductance coil with a variable condenser connected across it, by means of which the wave-length of this circuit can be adjusted so as to be in tune with the primary circuit and at the same time with the wave-length which it is desired to receive.

The inductance coil of this secondary circuit must be so placed relatively to the primary coil that the oscillatory currents occurring in the latter will induce similar oscillations in the former: that is to say, the axes of the two coils must be in line with one another, and the two coils must be sufficiently close together.

These circuits are shown diagrammatically in Fig. 6, where A is the aerial, I the aerial tuning inductance, C the aerial tuning condenser, P the primary coil, and E the earth, forming the primary oscillating circuit. The secondary oscillating circuit is formed by S, the secondary coil, and B, the secondary tuning condenser; the common axis of the primary coil and the secondary coil is indicated by the dotted line XY. The method of applying the potentiometer to the crystal in this case is shown in Fig. 7.

By applying our detector, as shown in the diagram, across the secondary inductance coil, we shall be applying it in the most efficient manner possible, since no matter to what wave-length the secondary circuit is adjusted the detector will be applied to the whole of the inductance in that circuit.

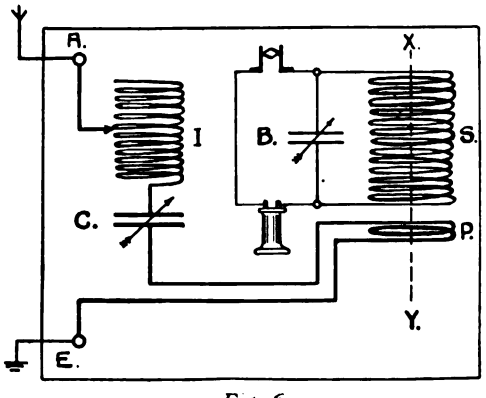

Fig. 6

57. **Proportion of Inductance and Capacity in Secondary Oscillating Circuit.**—

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Another point, however, which we have not yet touched upon, affecting the efficiency of the crystal detector, is the proportion of the inductance to the capacity of the oscillating circuit to which the detector is applied. In addition to the fact that to obtain maximum efficiency it is necessary that the detector be connected across the whole of the inductance, it is found in practice that the greater the inductance of that circuit compared with its capacity, the more efficient will the crystal become.

The reason for this will be explained in the next article, but for the time being we must take it as a fact and develop our receiver accordingly.

At first sight it would appear that there is no limit to the amount by which we can increase the inductance of the secondary coil, S, so long as we reduce the capacity of the condenser, B, in proportion. This, however, is not the case, for by increasing the number of turns on the inductance, S, we not only increase the inductance of the circuit, but also the capacity.

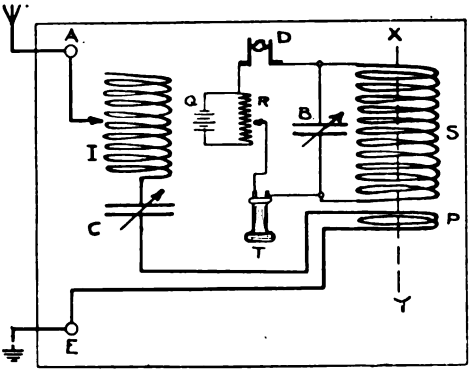

Fig. 7

Up to the present we have regarded coils of wire as having only the quality of inductance. As a matter of fact, however, every coil of wire has self-capacity, and for this reason it is found that every coil of wire, even without a condenser connected across it, forms an open oscillating circuit and has all the essentials of an oscillating circuit—that is to say, the two qualities of inductance and capacity. This self capacity then immediately limits the amount of inductance we can use, for in increasing the inductance we cannot avoid increasing also the capacity of the circuit.

The most efficient coil that we can design for the secondary circuit of the crystal receiver is therefore one whose wave-length by itself will be the required value without the addition of any extra capacity. Our adjustable condenser, however, is necessary in order to enable us to increase the wave-length of the secondary circuit, but again we are limited to the extent to which we can vary it by the fact that as we increase the capacity across the inductance so do we decrease the efficiency of our detector when applied to that circuit. (*See paragraph* 57.)

In practice it is found that without materially affecting the efficiency of the detector we can connect a sufficiently large capacity across the inductance to increase its wave-length to about two and a half times its original wave-length. If we go beyond this point the reduction in the efficiency of the detector becomes noticeable.

We may say then that with a two-circuit receiver in which a crystal is used as a detector, **the maximum efficiency is obtained when the capacity across the secondary condenser is reduced to zero.** Further, we may say that **the maximum wave-length to which it can be efficiently tuned will be about two and a half times the value of its minimum wave-length.** Thus, if the shortest wave-length which a station is required to receive is 300 metres, the receiver will be designed so that the minimum wave-length to which it can be adjusted will be 300 metres, and its maximum wave-length will then be about 750 metres.

Where longer ranges of wave-length than these are required, special arrangements have to be made by which the secondary inductance coil can be changed; thus if a receiver is required to receive wave-lengths of any value between 300 and 1,500 metres, it will have two secondary inductance coils, one of which will allow the receiver to be tuned up from 300 to 750 metres and the other from say 600 to 1,500 metres.

Share Market.

LONDON, *October* 21, 1913

The prices of the various Marconi issues show little change, and are as follows.—Ordinary $\frac{3}{16}$, Preference $\frac{1}{8}$, Canadian 9/6, Spanish $\frac{9}{16}$, American $\frac{5}{16}$. Rights on New Shares, 1/1½.

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Practical Hints for Amateurs

Home Made Long-Distance Apparatus

By "A. TINKER"

THE following account of a receiving apparatus which I set up recently may interest many of your "amateur" readers. I believe the designs are rather novel, especially the condenser and the potentiometer.

The condenser which I describe is easily made, and can be produced by an amateur carpenter, without any special tools; on the other hand, the rotary condenser is difficult to make satisfactorily.

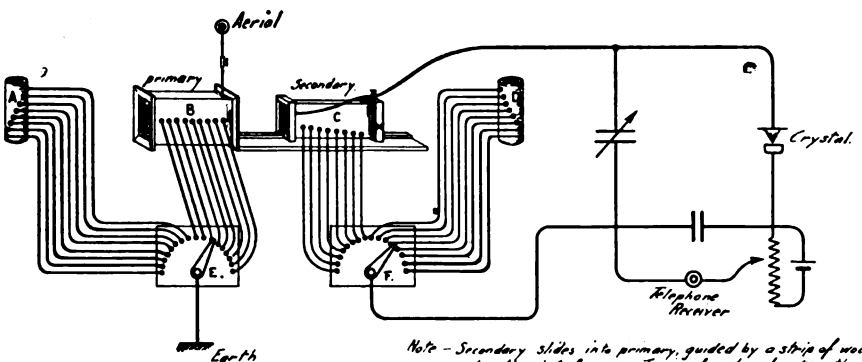

Fig. 1.

Note – Secondary slides into primary, guided by a strip of wood, slots being cut in the photo frames. To give freedom of motion, the leads from it are fixed to the right of the frame at x, and coiled into spirals between that point and the point switch to allow them to extend, as the secondary is pushed in.

Fig. 1 shows the apparatus partly as a sketch and partly diagrammatically.

It was made chiefly from old boxes, photo frames, earthenware drain pipes, and some pieces of spring brass. In use it has been found most successful.

The chief point about it is that it has no sliding contacts, the point switches being easily made with brass screws and a piece of spring brass. The box-shaped transformer is more easily made than a cylindrical one, and with photo frames at the ends looks quite neat.

Instead of using insulated wire, bare copper wire was used, with string wound alongside to keep the turns of the coils from touching, but no doubt it would have been better to use enamelled wire and no string.

Though not shown in the diagram, to avoid confusion, there were several separate drainpipe coils on both primary and secondary, with tappings led to the point switches.

The following articles were bought:

Receiver and blocking condenser.

Carborundum crystal.

Dry cell.

A few binding screws.

4 yards electric bell wire.

Some zinc sheet for making variable condenser.

20 S.W.G. and 23 S.W.G. copper wire for coils and aerial.

The cost of this amounted to two guineas in all, but I do not include the value of such things as brass screws, pieces of spring brass, and other small items which I found about the house or in the tool shed.

Fig. 2 is a sketch of the variable condenser, which is made of zinc plates and the glass of old full-plate photo negatives. By using glass as a dielectric, instead of air, the capacity is increased about seven times for the same area of plates. I used six sliding

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plates and seven fixed ones, with eight glass plates, in order to have glass on the outside of the whole lot, as well as between the plates. By making the fixed plates shorter than the glass and arranging the stop so that the

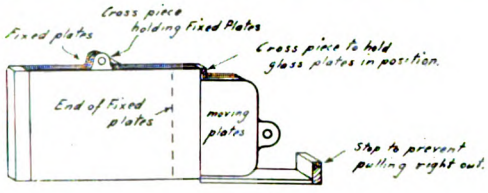
Cross piece holding Fixed Plates
Fixed plates
Cross piece to hold glass plates in position.
End of Fixed plates
moving plates
Stop to prevent pulling right out.

Fig 2

moving plates pull nearly right out, a very small capacity can be obtained for short wave lengths.

It is necessary to have washers between the plates where the bolts pass through the lugs to keep them properly spaced.

The setting up of the crystal needs no description, as there is nothing novel in the design of it. It was mounted on a piece of brass by dropping it into a pool of molten solder.

The potentiometer is shown in Fig. 3. This is on the point switch principle, in order to avoid the difficulty of making an efficient sliding contact.

I used ¼ in. brass nails, and 23 feet of that

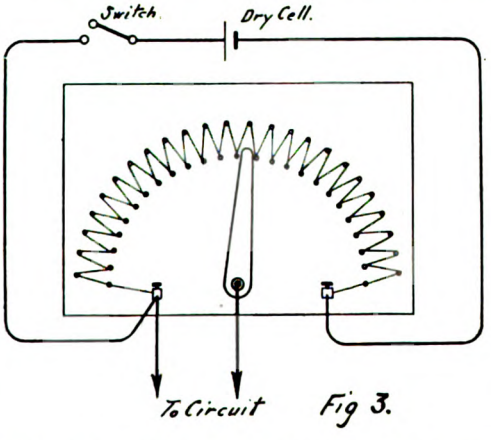

Fig 3.

thin wire which is used for making up nosegays.

This form of potentiometer can be made in half an hour, and is very successful.

The aerial is double, 240 feet long, average height 30 feet, slung from two fir trees with jam pots as insulators

I found that I could bore holes in jam pots with a file fixed in a brace.

The apparatus which I have described is very efficient, but the great point about it is that it can be made up with the ordinary tools that are generally found about a house. As I have no lathe or drills for cutting metal, I had to design the apparatus to suit the tools available.

AMONG THE AMATEURS

Association Topics

THE Wireless Society of London has just come into existence with the determination to carry out a very ambitious programme, upon the success of which the amateur wireless world should reap considerable benefit. The Society has received the blessing of Sir Alexander King, the secretary to the Post Office, who, on behalf of the Postmaster-General, wrote "welcoming the formation of such a society, and indicating that certificates of its advisory committee would be accepted by him as qualifications for the granting of licences."

* * *

At the inaugural meeting held recently Mr. F. Hope-Jones, who presided (and whose election as chairman of the Society was confirmed), explained that the first object of the Society was to guard the interests of all their fellow-workers in wireless telegraphy by securing the granting of licences, their permanency or free renewal in the case of all *bona fide* and competent experimenters. Applications for licences had increased so enormously during the last six months that there was a distinct fear lest the Post Office authorities should take drastic steps to repress the irresponsible amateur. A deputation from the Society recently interviewed certain officials at the General Post Office, and he (Mr. Hope-Jones) was satisfied that they would have the support and goodwill of the Postmaster-General if they took care that no more complaints were received of interference with commercial and Government stations by the use of excessive powers and untuned aerials, such as were now frequently used by irresponsible experimenters, and if they exacted from their members an undertaking that they would keep within the limits of their licences. More than this, they had been unofficially

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informed that such an organisation would be welcomed by the authorities, and it was easy to see that, in the very indefinite state of the

Mr. F. Hope-Jones, Chairman of the Wireless Society of London

law, they could be of great assistance in discriminating between those who should and should not be trusted with licences.

* * *

There is ample scope before the Wireless Society of London for work which can be extremely beneficial to the community. But to achieve any substantial measure of success it must co-operate with the provincial societies already in existence, whose influence in organising and controlling the operations of amateurs has tended to instil in them a due sense of responsibility in the handling of apparatus. Writing of amateur associations in the August number of this magazine we said: "We are probably only at the beginning of what will ultimately become a very large and useful movement, with associations of amateur experimenters in every important centre co-operating for the common benefit of their members." The means for organising a national federation of amateur wireless societies foreshadowed in that sentence is available in the establishment of the Wireless Society of London if the Committee will avail themselves of their opportunity.

* * *

Incidentally, we must congratulate the new Society upon its excellent choice of title and upon the good taste of the committee in avoiding the word "Club," which is apt to convey a misleading impression concerning the functions of the body it designates. The Wireless Society of London owes its inception to Mr. R. H. Klein, to whom is mainly due the successful launching of the Society. In addition to Mr. Hope-Jones and Mr. Klein, the following gentlemen form the committee: Messrs. H. F. Brand, L. McMichael, W. J. Shaw, V. W. Delves Broughton, W. J. Fry, E. W. Kitchen, L. F. Fogarty, A. G. Hansard, and Dr. F. C. Knight. Mr. A. A. Campbell Swinton is the Honorary President of the Society.

* * *

It is some little time since we recorded the doings of the Derby Wireless Club, but it has not been idle in the meantime. Indeed, it has been indulging itself in new achievements and appears to be considered quite an authority in the world of amateurs. In addition to experimental work, the club has recently started a systematic course of elementary electricity and magnetism as applied to wireless. Mr. R. A. Briggs has undertaken to give a half-hour lecture each Wednesday on this topic

Mr. R. H. Klein, Hon. Sec., Wireless Society of London

The Liverpool and District Amateur Wireless Association is one of the most energetic societies of its kind in this country, and a good deal of useful work is carried out at many of the numerous meetings held. At a recent meeting the chief subject under consideration was that of "Loose coupled receiving sets," remarks being contributed by Messrs. Coulton and Frith, the former giving the outlines of a set he has at present in use, and commenting upon the much better signals he is now receiving. The subject was raised of dividing the members

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into groups, so that each group might devote itself to experiments in specific directions and report results from time to time. A proposal was also put forward that the meeting night should be changed from Thursdays to Tuesdays, so that any members who desired may attend the "Wireless Lectures" at the Liverpool University, which are held on Thursdays.

* * *

The Cheshire Radiographic and Scientific Society propose holding a public exhibition in December next, at which a complete transmitting and receiving set will be shown working, and members' apparatus exhibited. This society was formed in February last by a number of experimenters in wireless telegraphy, the objects being the association of its members for mutual assistance in all scientific studies, and in particular radio-telegraphy and high-frequency electricity.

* * *

At the usual monthly meeting of the Northampton and District Wireless Club a successful attempt was made to get Eiffel Tower signals on an indoor aerial. Although the connecting up of the apparatus was not commenced until 7 p.m., Eiffel was heard plainly enough to be taken down. The aerial was a single wire about 30 ft. to 40 ft. long, and was fastened to a chair-back, from there to a nail in the wall about 7 ft. to 8 ft. from the floor, and brought back to the table. The room was an upstairs room at the grand stand of the racecourse, and the meeting was held on October 1st. Rubber bands were used as insulators, and a Perikon detector and double-slide inductance, with blocking condenser, and 8,500 w. phones, and 18 S.W.G. bare copper-wire aerial, earth to a water-tap.

* * *

The members of the Birmingham Wireless Association were recently favoured with a demonstration and brief lecture by Mr. J. H. McKeever and Mr. W. D. Sell, both of the Birmingham Wireless School. These gentlemen stepped in at very short notice to take the place of the lecturer who had been announced to attend, but who was unavoidably prevented from fulfilling his engagement. The lecture dealt with the early history of wireless telegraphy and the development of the syntonic theory.

An effort is being made to form a wireless society for the districts of Croydon, Sutton and Epsom, and as there are a number of experimenters in these districts there seems ample room for a useful society. We would advise those interested to communicate with Mr. Stanley J. J. Holmes, of Yelverton, Court Road, Sutton, Surrey. Mr. Holmes proposes to erect a wireless station for experiments to be carried out by members of the society.

* * *

The station which the Committee of the Dublin Wireless Club are erecting at their headquarters is making satisfactory progress. It has been decided to erect two 33 foot poles, held in position by bolts through the wall and raised about 7 feet from the ground, thus making the height about 40 feet. The aerial is to be of the four-wire Admiralty pattern and 150 feet long. Mr. Britton has undertaken the erection and painting of the poles and to supply the necessary wire and fittings for the aerials and lamps for the illumination of the club rooms in the evenings. Various members offered to supply apparatus.

* * *

We have little room left to deal with the display of amateur wireless apparatus which was shown at the *Model Engineer* Exhibition held during the past month. Some interesting models were shown, and among the exhibitors of wireless were the British Telegraph Instrument Co., Ltd., whose exhibit of wireless apparatus was one of the most attractive features of the exhibit. Messrs. A. W. Gamage, Ltd., and the Static Scientific Co., and Messrs. Richard Melhuish & Co., Ltd., were among the other exhibitors. We hope to refer to this exhibition again in our next number.

* * *

At a meeting of the Leicester Association held on October 11th a paper was read by Mr. Skeets on "Wireless in Theory." The members are busy preparing for their exhibition, to be held on November 8th in the Large Hall of the Vaughan College. The Hon. Secretary is Mr. H. Wildbore, 1, Bosworth Street, Leicester.

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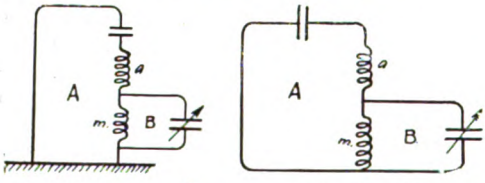
QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

J. F. L. (Eltham).—*The Condenser in Parallel and Series.*—What is the effect of placing a condenser in parallel with an inductance, compared with placing the same condenser in series with the same inductance?

Answer.—For the purpose of bringing the question under simple mathematical treatment, we may regard an aerial as being similar to a closed oscillatory circuit—*i.e.*, as having all its capacity to earth situated at its summit and all its inductance in the earth-lead. The effect of inserting a condenser in the earth-lead is then clear, for we are placing it in series with the aerial capacity to earth, and thus reducing the effective capacity of the aerial to earth. As the inductance remains unchanged, the effect is, of course, that the wave-length is shortened. In the case of the condenser shunting the inductance the action is more complicated. Adopting our former assumption, we can represent the conditions diagrammatically thus:



Here we have two oscillatory circuits, A and B, of different wave-lengths coupled together in "auto-jigger" fashion. Now, whenever two circuits are coupled together, the lengths of the waves emitted are affected.

If λ_1 be the wave-length to which A is tuned,

λ_2 " " " B "

then the actual wave-lengths emitted would be

$$\lambda_1^1 = \sqrt{\frac{\lambda_1^2+\lambda_2^2+\sqrt{(\lambda_1^2-\lambda_2^2)^2+4k^2\lambda_1^2\lambda_2^2}}{2}}$$

and $$\lambda_2^1 = \sqrt{\frac{\lambda_1^2+\lambda_2^2-\sqrt{(\lambda_1^2-\lambda_2^2)^2+4k^2\lambda_1^2\lambda_2^2}}{2}}$$

where k is the coefficient of coupling, depending on the proportion which the inductance m, common to both A and B, bears to the total inductance $a + m$. Two waves are therefore radiated (or conversely, received), one long and one short; it is the long wave which is utilised in the "shunt-capacity" method of tuning. This "shunt-capacity" method will give fairly good results in expert hands, but it is not one to be recommended to the amateur. An ordinary tuning-inductance is effective and at the same time much simpler to use.

"OMEGA" (London).—Your down-leads must either come from one end of the horizontal part or from the centre. As you have them in the drawing, they form a quite unsymmetrical T aerial. Best to take them down from A, using rope and insulator from ground to about the height of window. All wires separate everywhere except where they enter, and all of the same length. We would rather have two wires spaced, say, 8 feet, than five spaced a foot each. If you bring your down-leads from the end, A, then your natural wave-length in metres would be (approximately) length of horizontal part *plus* down-lead *plus* earth-lead (all in feet) all multiplied by 1·35. Your coils wound in discs with waxed blotting-paper between are unsatisfactory, because of the capacity from disc to disc. The air-gap between the primary and secondary of a loose-coupled tuner is to avoid this effect. The air-gap need not be *too* big. We hardly think your failure to get many short waves is likely to be due to any idiosyncrasy of your crystal. Perhaps you are a long way inland? Are you sure your tuner can tune properly to the short waves? And that when so tuned, the coupling is not unduly weak, owing to so few turns of the primary being in the circuit? Or, perhaps, those turns which *are* in the circuit are at the end of the coil which is right away from those turns of the secondary which are in the circuit—thus producing a very weak coupling. In fact, without further information, we can only advise you to try tightening your coupling for these short waves.

H. B. L. (Wetherby).—Your arrangements for aeria seem quite good. Use a two-wire aerial at least 5 feet apart. A single wire will do for down-lead, but two are better. The only place where the two wires should join is where they enter the house. For comment on diagram of connections, see reply to W. A. M. in this number. Aerial connections all right; slightly better to connect aerial to terminal 6 and earth to terminal 5, thus keeping earth as far away as possible from crystal-end of secondary. Your ten-way switch on secondary will be all right, since you are going to have a variable condenser as well, for fine adjustments. No. 28 for primary, No. 36 for secondary, will do. Single 2,000 ohms telephone might be more sensitive, but the double (1,500 ohms) will be more convenient. Zincite and pyrites is good enough; but carborundum with battery is really the most satisfactory.

W. A. M. (Liverpool) gets inconsistent results with ship signals on his crystal receiving set, and fails to get any of the long-distance stations. He suggests that the fault lies with his telephones, which are only of 100 ohms resistance.

Answer.—The telephones are quite enough to account for your failures. To see whether they are the only weak points in your set, borrow a motor-car trembler coil and connect up as a step-down transformer to your telephones. But, referring to your diagram of connections, why *will* you amateurs insist on ruining your oscillating circuits by putting the crystal—some thousands of ohms in resistance—in series with the circuit? Its place is in series with the telephone *across* the condenser of the oscillating circuit.

P. K. S. (Rugby).—Is there any remedy for an aerial which is near to some 2,300 volt alternating mains, and which, therefore, gets disturbances from these which prevent proper reception?

Answer.—Such mains should not produce serious trouble unless they are supplying power to tramcars, when the sudden fluctuations due to the starting of the cars may upset the aerial. If you are using crude receiving circuits with little power of selectivity, you will be liable to get interference which would entirely vanish if you used a proper syntonised arrangement. If, in spite of using such an arrangement, you still find interference, your only plan will be to try a "balancing aerial," so arranged as to be affected by the mains, but not, to any appreciable extent, by the signals from the distant stations; the effects from the mains on the two aerials being made to oppose one another in the receiving circuits.

H. E. M. (Canadian Central Wireless Club, Winnipeg).—It is contrary to our rules to give such details as you ask

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for of a patented article. We will help you as far as we can without breaking this rule. The design of the receiver will depend almost entirely on the nature of the detector you intend to use it with. The receiver you mention is designed to work specially with the Marconi Magnetic Detector, which may be called a "current-working" device of low resistance. Therefore in this receiver the condensers are all large, and the inductances small; whereas, in the corresponding receiver designed to work with a valve or crystal detector, the condenser in the detector circuit is very small, and the inductance correspondingly high. The first receiver, however, will work very well with very low-resistance crystals, if properly adapted. Except for the lack of ease in adjustment, your suggested plan of using a small, continuously-variable condenser in parallel with a larger condenser variable in steps—as a substitute for a larger continuously-variable condenser—is all right. If you have a thorough grasp of the elements of the subject, and have and use skilfully a suitable wavemeter, you should be able to get the right values for the various circuits. If you have no wavemeter, then we think the best use to which you could put that variable condenser would be to make a wavemeter out of it.

G. A. J. (London).—I am erecting a wireless set; the aerial will be suspended from a poplar tree (12 feet high) at the end of the garden to the roof of the house (40 feet), and will comprise about 100 feet of wire. Will this be suitable for receiving from Eiffel Tower and other stations?

Answer.—Your aerial is not a good one, being very low at the one end, and rather short; but in skilful hands it ought to give signals from several stations. Could you not put a mast up in that tree and so raise that end of the aerial? No; a variable condenser is not absolutely necessary in a receiving set; quite good signals can be received without the use of even a fixed condenser.

B. H. B. (Ware).—(1) I have a detector with three crystals, graphite, copper pyrites, and silicon on the stand, and a zincite crystal in the upper cup. I was told to use the zincite with the graphite and copper pyrites, but a brass point with the silicon. I can get no result with the brass point, but find the zincite acts on the silicon. Would a sharp steel point do better? and can you explain why I get no results with brass (I use a potentiometer)? (2) I do not get short wave-lengths very loud, even with my condenser right out. Primary and secondary are both box shaped, sliding one into the other, about 10 inches square and one foot long each, primary No. 20 enamelled wire, secondary No. 22. The longer wave-lengths I get quite plainly. Would it be better to have a separate transformer of smaller size for the 100 to 300 metre stations?

Answers.—(1) We can no more answer for the behaviour of these "fancy" crystals than we could prophecy or account for the actions of anything whose conduct is *varium et mutabile semper*. Silicon, in particular, is notoriously difficult to deal with. Why not devote yourself to carborundum, and get hold of some really good specimens? They take a lot of beating.

(2) Yes; we have no doubt that you ought to have a separate receiving jigger for the short wave stations. The self-capacity of the coils of your big set would be so great that it is quite probable that even with your condenser right out the circuits are tuned to too long a wave.

L. W. P. (Pomfonne, France).—Can I work a morse writer with my wireless set to receive Eiffel Tower signals, which is only about 30 miles from my house. I have already a pair of relay magnet coils of a resistance of 4,500 ohms. each. Would these be any use to me?

Answer.—The easiest way would be for you to use the old-fashioned coherer. With such strong signals as you would obtain you could use a very insensitive coherer, and this would tend to make it quite reliable and far less troublesome than those used in the old days when the great object was to attain as great distance as possible. Your relay magnet coils would come in useful for making the relay for working the coherer-tapper and the Morse inker. The whole apparatus need not be at all expensive. If you do not like the idea of a coherer, you might try to make a very sensitive relay which would work off the current through a crystal-receiver. This is only practicable with very strong signals, but your case should be a favourable one. If you could borrow a microammeter and see for yourself what current you can get from these signals through a crystal-receiver, you would know more or less whether a home-made relay could do the work.

W. N. (Wokingham).—If we are to take your sketch as strictly representing your connections and arrangements, your jigger-secondary is coupled all the way along with the primary, so that there is *no* "high-potential end to be kept away from the earth-connected primary." In this case you would get no change by altering the connections round. In a properly-designed receiver there is so much difference between the high-potential end of the secondary (the end right away from the primary) and the low-potential end, that a touch of the finger on the former will entirely stop signals, while on the latter it will barely affect them at all. The crystal should be connected to the side of the condenser which goes to this high-potential end; and it is this potential which drives the signal-current through the crystal. With a jigger-secondary wound in more than one layer, not only do you not get this free end, but also one layer has a distinct capacity to the other, and this interferes with the tuning.

A. A. (Glasgow).—It is desired to work small wireless sets over hilly country for a distance of about 14 miles with hills of about 600 feet intervening. The sets work satisfactorily oversea for a distance of 30 miles.

Answer.—We think there should be satisfactory communication up to a distance of about ten miles, but we greatly doubt whether it would be uniformly satisfactory over the full distance of 14 miles under all conditions—with a dry earth, for instance.

A. S. (Liverpool).—In the third paragraph in "Questions and Answers," in September issue, you say that an old motor-cycle ignition coil will do for the transmitter. Do you mean a trembler coil?

Answer.—Yes. What is wanted is a means for producing a spark, and to get an induction coil to do this it is necessary to have some kind of rapid make-and-break—hence the necessity for a trembler or some similar arrangement.

BEGINNER (Forest Gate) asks for "instructions for making a two-slide tuning coil," which we regret we cannot give in an answer to a question. He has a cylindrical (solid) piece of wood 7 inches long by 6 inches diameter, and asks whether that will do as well as a cardboard tube for winding the wire on. The wooden cylinder will do quite well; he had better wind two or three layers of paraffin-waxed paper round it before putting on the winding.

ZETA.—Sorry, but in order to understand your query we must have fuller particulars; a diagram of connections is necessary, also the gauge of wire in the various coils. A 9 inch by 3 inch inductance coil might have any value, depending on the number of turns which it contains. Moreover, your fixed and variable condensers might be of any value, and it is impossible to get an idea of what is happening unless we are told more about them. If you could tell us that you have a wave meter, that you use it properly, and that you are certain that your circuits are capable of tuning properly to the waves you refer to, then, of course, we should have something to go on. Your aerial seems all right; if everything else is correct you should get strong signals from the stations which you mention as coming in weak, and there is no reason why you should not get Poldhu. The fact that you get Cleethorpes clearly does not show that your apparatus is really working well, since the distance is so small. Thank you for your kind remarks about THE WIRELESS WORLD.

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Personal Items.

Mr. John Beecroft Beaumont, late Cadet Sergt., Leeds University Contingent, Senior Division, Officers Training Corps, has been appointed Lieutenant in the Northern Wireless Signal Company, Northern Command Signal Companies, Royal Engineers (Army Troops).

By an arrangement just effected, Mr. Edward J. Nally will become Vice-President and general manager of the Marconi Wireless Telegraph Company of America. Mr. Nally, who is still in his prime, has been for more than thirty-five years connected with the telegraph business, starting as a messenger boy with the Western Union Telegraph Company. He recently resigned as vice-president and general manager of the Postal Telegraph and Cable Company, after a service of nearly twenty-five years. Mr. Nally's experience and reputation as a telegraph man fit him in an eminent degree for the position which he has just accepted, and will be especially valuable to the company in connection with the Trans-Atlantic and Trans-Pacific telegraph service, which it is expected will be opened to the general public by the close of the present year.

Marconi Philatelic Society.

Another very interesting evening was spent on October 17th, when Mr. A. W. Torode, by special request, read a paper on "The English Stamps of King George." Doubtless it will be news to many readers, equally as much as it was to some of the members present, to learn that since the accession of King George there have been no fewer than 26 varieties of our own English halfpenny stamps and 25 varieties of the penny. Many specimens of the different varieties of watermarks were exhibited by Mr. Torode, and he received the warmest thanks of the members present, who fully appreciated both the reading and the exhibition. It is hoped that during the coming season one or two other members will follow the example of Mr. Torode and give the Society the benefit of their researches in the particular countries in which they have specialised.

Swimming.

The Swimming Club finished the summer season's programme with the Club Championship contest of 220 yards, which proved to be a very exciting affair. The entries totalled eleven and the heats took place on the 9th and 10th inst. when the first three of each heat passed into the final.

This took place at the headquarters on Thursday, October 16th, and was won by Mr. A. S. Free, of the Accountants Department, Mr. Castle and Mr. Litteur being second and third respectively. Mr. Free is to be congratulated upon his excellent win, by which he holds the cup for one year and receives a gold medal.

Orchestral and Choral Society.

The Orchestral Society has been continuing its weekly practices. Overtime work and night classes have once or twice played havoc with the attendance, but the calibre of the orchestra has, notwithstanding, improved greatly. In association with the above three singing practices have been held in the last three weeks. They have proved increasingly attractive, and last week the number of performers reached the grand total of thirty. There is reason to hope that this record will be beaten in the near future, while the enthusiasm shown over such items as the "Soldiers' Chorus" and "Queen of Angels" augurs well for rapid advance in musical development also.

Buyers' Guide.

It has been truly said that "of the making of books there is no end," and certainly the reading of publishers' catalogues, which at this time of the year appear in battalions, is likely to become wearisome to the flesh. But this evidence goes to prove that we of the twentieth century are dependent more than in all preceding ages on book-learning and book-reading. Nevertheless most of us have no time to test the merits or demerits of new literature, and often it is dangerous work to buy a new textbook on any subject we may fancy merely on the authority of a review or of an advertisement. Further, it is, in nine cases out of ten, best to stand by recognised authorities and old favourities, and if this plan be followed there is the added advantage of possibly being able to procure such books second-hand, which means the maximum value at a minimum outlay, and there is no firm which has so fine a collection of first-class books, and more especially technical and scientific works, as Messrs. W. & G. Foyle, of 121 to 123 Charing Cross Road, W.C. Their catalogue can always be obtained on application, and is worthy of the perusal of all wireless operators and engineers.

* * *

One of the most important articles in a wireless operator's kit, and, in fact, in all travellers' kits, is the waterproof, and it is an article on the purchase of which the greatest care must be exercised if it is to be a satisfactory investment to the purchaser. One does not want to be constantly buying waterproofs, a good one will last years, and withstand heavy wear, but it must be good, and, as with all articles in which rubber plays an important part, the purchaser is bound to rely chiefly on the credit of the firm with which he is dealing. Therefore he cannot do better than deal with such a well-known business house as Anderson, Anderson & Anderson, Ltd., of St. Paul's Churchyard, E.C., for their goods are known throughout the world as bearing the hall mark of excellence in manufacture, while their india-rubber regulation waterproofs—and without rubber or oilskin you can have no real waterproof—have always been officially sealed as the authorised standard garment by the naval and military authorities.

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WIRELESS WORLD

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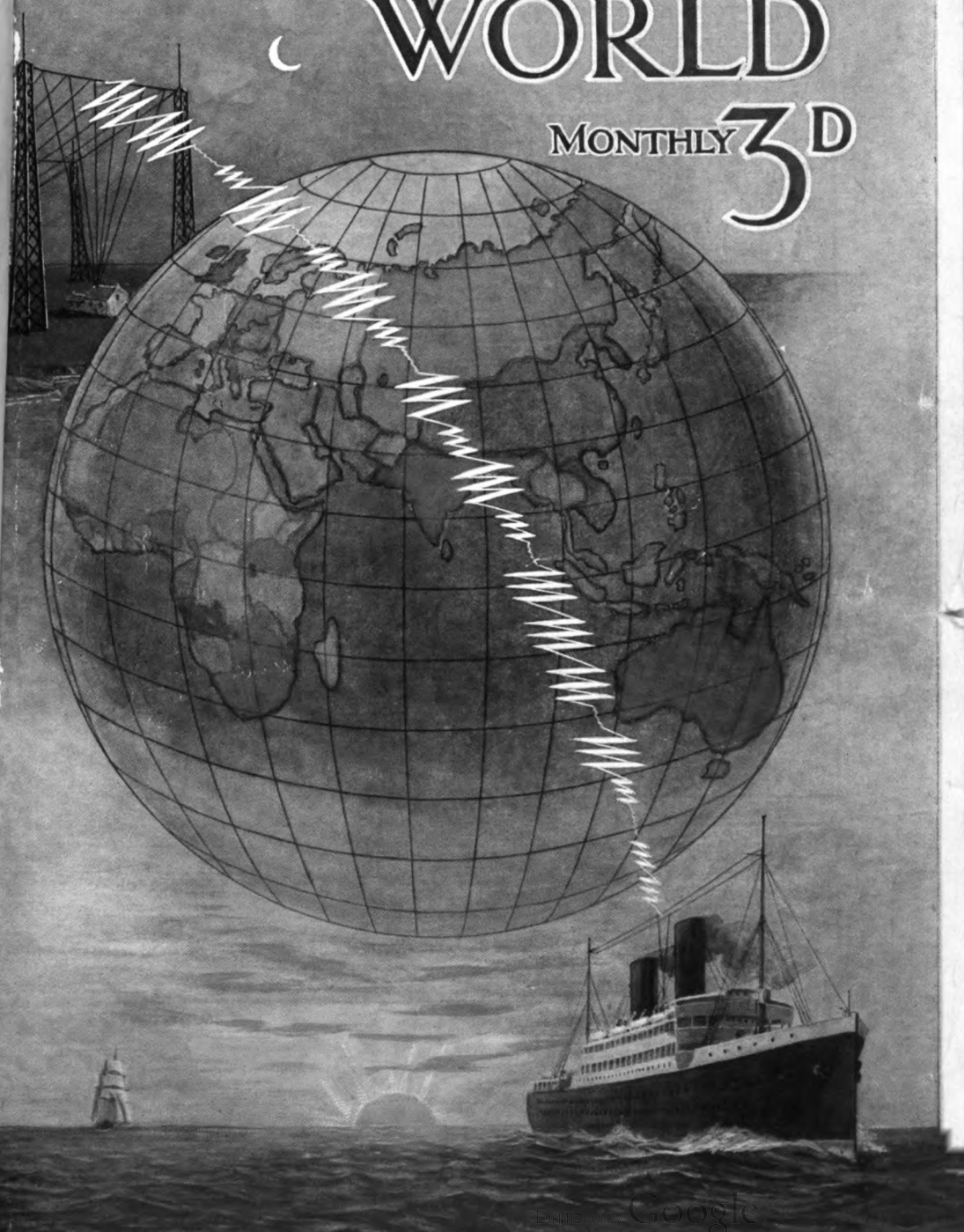

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The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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Vol. 1.—No. 9. (New Series) December, 1913. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

The Perils of the Sea.

THE news of the burning of the Spanish steamer *Balmes* which came to hand as we were about to close for press with this number emphasises the object lesson to the world of the beneficent power of wireless telegraphy which the burning of the *Volturno* afforded a striking reminder of last month. Happily, the latest disaster was not attended by the unfortunate consequences which followed the *Volturno* conflagration, for by the means of wireless telegraphy another vessel was able to reach the burning ship before the flames could obtain complete mastery. The story may be briefly told. The Spanish steamer *Balmes*, which hailed from the Gulf Ports and Havana and was sailing for Cadiz, arrived on Sunday, November 16th, at Hamilton, Bermuda, convoyed hither by the Cunard liner *Pannonia*, with the smoke and flames still bursting from her forward decks. The fire broke out three days previously, and when Capt. Capper of the *Pannonia* was about a thousand miles from New York he heard the wireless call for help, and immediately changed his course to find the *Balmes*, which he estimated to be about 200 miles to the south, with 103 passengers on board and 56 officers and crew. During the interval which elapsed between the receipt of the call for help and the arrival of the rescuing vessel, the operator on the Cunarder was sending short messages of encouragement telling the passengers and crew of the hourly progress made by the *Pannonia* and of the arrangements to help everybody.

This incident lends point to the proceedings now taking place in London, where representatives of the different nations are meeting together with a view of taking combined action on behalf of the common interests of humanity. The work of the Conference really falls under two heads. Safety at sea may be achieved either by the avoidance of accidents or by minimising the results of such accidents as do occur. Thus, the first thing necessary is to see to the strength, stability, and seaworthy qualities of vessels, to insist on the observance of all conditions of careful navigation, to take steps to keep sailors informed of the presence of such lurking perils as ice or derelicts, and to take care that full and adequate preparations are taken to warn ships near to land of the dangerous points of the coast. Here, wireless telegraphy figures as prominently as it does in that section of the work of the Committee concerned with the question of the provision of life-saving appliances. This is undoubtedly a matter where the maritime nations of the world should act in unison. If the shipowners of one nation were made to observe rules and regulations which were not applied to their rivals in other countries, it is clear that they would be placed at a serious disadvantage in the fight for the maritime trade of the world. So that if there were no assurance of international co-operation it is not improbable that many Governments would be loath to pass legislation desirable and even necessary in the interests of the public safety. We may hope, therefore, that the Conference will succeed in reaching an agreement as to the measures which should be adopted to minimise the perils of travel by sea.

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SIR W. H. PREECE.

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Personalities in the Wireless World

SIR WILLIAM PREECE

Born February 15th, 1834.
Died November 6th, 1913.

THE passing away of this distinguished electrical engineer must be our excuse for departing from our usual practice of dealing on this page only with living personalities who are contributing to the development of wireless telegraphy. Sir William Preece was an ardent investigator in many branches of electricity, including inductive wireless telegraphy, and although his name is not directly associated with any of the revolutionary discoveries in this science, there is scarcely one that did not owe something to his practical experience and his inquiring mind.

His first experiment in inductive wireless telegraphy dates as far back as 1882, and for some years thereafter he experimented in all parts of the country and published the results in numerous papers.

The inductive method of wireless telegraphy depends for its effectiveness on the fact that an electric current moving backwards and forwards in one wire will cause another electric current to move forwards and backwards in another wire within its field. For practical purposes this system is limited in its value by the fact that in order to increase the distance over which signals are transmitted it is necessary proportionately to increase the length of the parallel wires opposing each other. As the parallel wires had, roughly, to be as long as the distance between them, it will be seen that this method had limits of practical application, even over short distances.

Sir William Preece on one occasion tried to signal by these means between England and Ireland, and on a Sunday night seventeen years ago connected up the main telegraphic lines through the length, north to south, of England and Ireland, thus making two enormous parallel circuits. The results, however, were unsatisfactory, and no definite messages from either Ireland or England were received.

It was about this time that Sir William made the acquaintance of Mr. Marconi, who demonstrated his invention—which was not that of inductive telegraphy, but which depended on electromagnetic waves—before Sir William Preece and other Post Office officials. But, curious as it may appear to-day, there is abundant evidence to show, by the utterances of theoretical and practical electricians of fifteen years ago, that the system at which Mr. Marconi was working was not believed to be of great practical value. Nevertheless, Sir William evinced a deep interest in Mr. Marconi's early experiments in England, and it was due to his influence that Mr. Marconi received considerable encouragement from the British Post Office.

The name of Sir William Preece will always be chiefly associated with the growth and development of the system of inland telegraphs in Great Britain, and he may almost be said to have been contemporary with it. He was electrician to one of the private companies which existed before the system of Post Office Telegraphs was consolidated under Government control, and as he was present at the inauguration of that new system, so also he remained in office till another system of electric intercommunication—that of the telephones—had established its importance.

During his long career as Engineer-in-Chief to the British Post Office he was responsible for many far-reaching improvements for which the public are indebted to him.

Sir William Preece, who was created a K.C.B. in 1899, was a Fellow of the Royal Society and a LL.D., becoming, in 1898, President of the Institution of Civil Engineers. He married in 1864 Agnes, daughter of the late George Pocock, of Southampton. She died in 1874. Sir William's family consists of four sons and three daughters.

B

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The Welsh Wireless Station

PROGRESS OF THE GREAT TRANSATLANTIC STATION AT CARNARVON. THE SITE AND ITS ASSOCIATIONS. DETAILS OF THE BUILDINGS AND PLANT.

THE picturesque old city of Carnarvon will before long be possessed of an interest which will appeal to a wider public than merely historians and antiquarians. For soon the great Transatlantic wireless station which is being built at Cefndu will be completed and a new route of communication will be opened up with our *confrères* across the "herring pond." Then the ancient Kaer Seint yn Arvon of the *Mabinogion* and the birthplace of the first Prince of Wales will be lost in the modern Carnarvon, the possessor of one of the finest wireless stations in the world, and the little river which gives its name to the place will be forgotten in the greater wonder of this outpost of civilisation which has received its name from the city near by.

Panoramic View of the Station Site.

The construction of the station is now approaching completion. It is situated on the side of the Cefndu Mountain, and merely from a wireless point of view the site is admirable. The ground begins to rise immediately the Ceunant road, which stretches alongside the lower edge of the Company's land, has been passed, until in the extreme east of the site it reaches an altitude of some 800 feet. The station itself is built at a height of 750 feet, and the last row of masts is estimated to stand about fourteen hundred feet above sea level. Such is a description of the locality as it would strike a wireless expert, but from the point of view of the observer of natural beauty much more might be added. Standing upon the mountain side the view is particularly arresting. Looking towards the north the land lies spread out below till it reaches the water's edge. Beyond stretches the glitter of the sea, its loveliness emphasised by the proximity of Anglesea, with its flat tableland stretched out in serene amplitude in the midst of constant movement, like some giant leviathan ever basking on the surface of the waves. Further than this the eye on a fine day can penetrate the blue haze and catch a glimpse of the white shores of Ireland far out in the distance. Looking inland the noble mass of Snowdon makes an imposing spectacle as it stands out among its sister hills, while between lies the narrow valley of the River Senit, which falls into the sea at Carnarvon, where the crenellated outline of the noblest castle in Wales gives a touch of frowning dignity to the scene. It is a splendid spot for those who will be in charge of the station, and though in the winter months it is cold and swept by strong winds, a quick walk down to the valley below will bring them into

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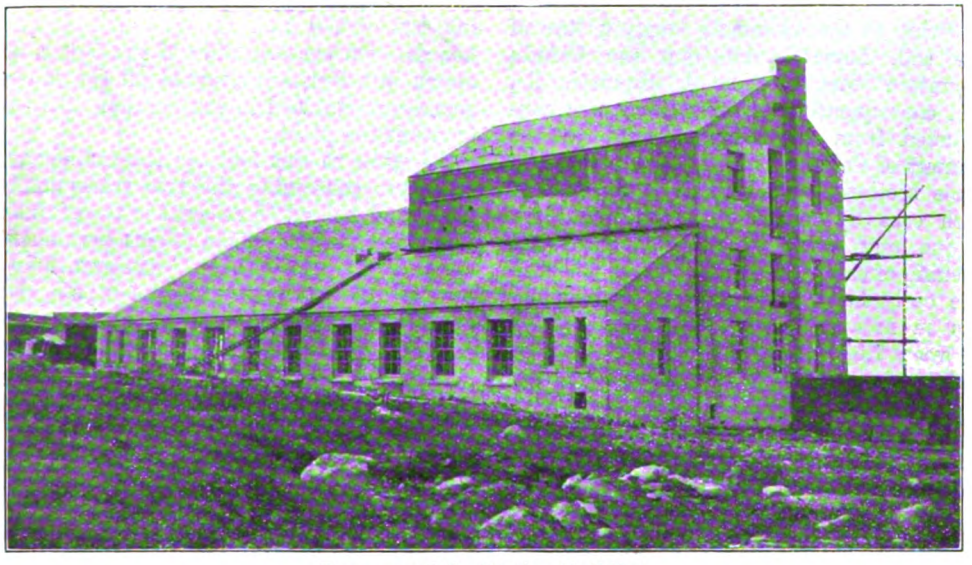
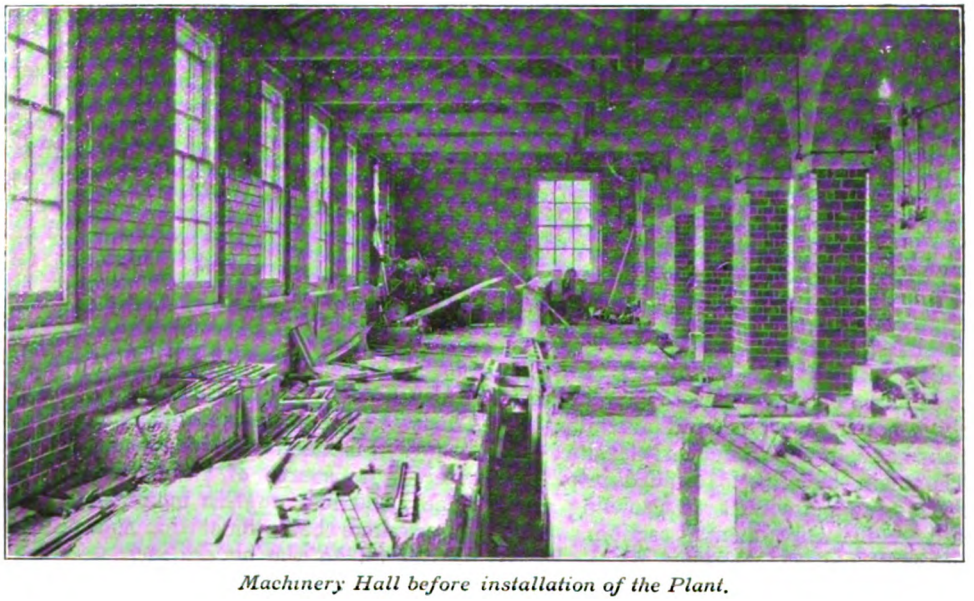


Progress of the Station Building.

another climate, for in all the lower-lying districts and along the coast it is warm and mild.

When completed this station will communicate direct with the second great station now in course of construction at New Jersey, just outside New York, and another direct line of wireless communication with America will then be opened up. At present the only route is *via* Clifden and Glace Bay, but the need of extended facilities has long been felt.

A description of the work which is being carried on at the New Jersey station has already appeared in THE WIRELESS WORLD, and we now propose to supplement this with a short account of the happenings on this side of the ocean, which we think should prove of interest to our readers.



Machinery Hall before installation of the Plant.

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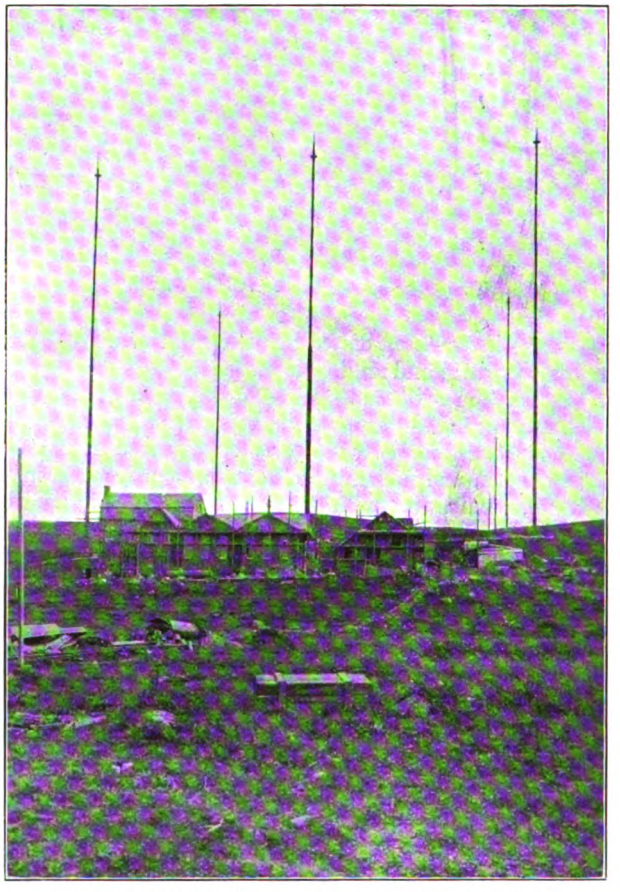
Owing to the extremely boggy nature of the soil, horse haulage up the Cefndu Mountain was considered impracticable, and consequently a light railway was constructed from the Ceunant road to the summit of Cefndu. This line is arranged in three sections, and haulage is effected in each case by means of a steam haulage engine and steel wire rope. Since the opening of this line early last summer between 7,000 and 8,000 tons of materials have been hauled up the mountain.

The transmitting aerial consists of 32 wires of silicon bronze, and is supported on 10 tubular steel masts each 400 feet in height. The foundations and anchors for these masts consist of very heavy concrete blocks, some 6,000 tons of material having been used in their construction. The earth system consists of two very wide circles of plates sunk in the ground, with the main building as centre. Extensions to this system are buried underground immediately beneath the aerial and extending as far as the eastern extremity of the site.



General view of the Station, showing some of the Masts.

The main building is divided into two sections—the permanent transmitting section and the experimental section. The permanent section consists of a large machinery hall which contains two generating sets of 500 h.p., and the main switchboards. On the east side of the hall is an annex in which are situated all the motor generator sets used in conjunction with the transmitting plant.

Adjacent to this hall are the two silence chambers containing the two transmitting discs, and behind these are the transformer room and various offices. This permanent transmitting section also contains spacious store rooms, workshop and shift-engineer's office.

The experimental section adjoins the main machinery hall on the west side, and will contain various machines to be used for special work in connection with Mr. Marconi's latest device for generating continuous waves. The upper floors contain the various details of the transmitting plant.

There will be no prime movers installed on the station; all the power employed is being brought from the North Wales Power Co.'s station, near Llanberis. This station, which is situated at the foot of Snowdon, is fitted with water turbines and receives its source of supply from a lake some 1,500 feet up this mountain. The water enters the power station at a pressure of 750 lb. to the square inch.

Power is delivered on the site to a small

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sub-station situated near the main building, and is transformed down from 30,000 volts to 440 volts, the latter voltage being suitable for running the main motors in the machinery hall.

An efficient fire service will be installed in the building, the mains being fed from a large reservoir which is being constructed higher up the mountain.

The plant at this station will be controlled and operated from the receiving station at Towyn, Merioneth, and land wires are now being installed to connect these two stations.

When completed the stations will work direct with New York, transmission and reception being carried on in duplex.

IMPERIAL TELEGRAPHIC COMMUNICATIONS

A SITTING of the Dominions Royal Commission, which has already sat in Australia and is visiting South Africa in the new year, was held in London, November 11th. Sir E. Vincent (chairman) presided.

Mr. Crabb, C.B., Second Secretary to the Post Office, gave evidence particularly with reference to cable communication with various parts of the Dominions. The Post Office had replied in a memorandum to a series of questions submitted to them as to the question of a State-owned Atlantic cable, and this formed the basis of a number of questions to the witness. The Post Office, it was pointed out, was of opinion that from a commercial point of view the provision of a State cable across the Atlantic was not at present justifiable. Replying to Mr. Tatlow (one of the Commissioners), the witness said the developments by leaps and bounds of wireless telegraphy no doubt contributed to the opinion of the Post Office that the present time was inopportune for establishing a State cable. There was a desire in every way to consult the British Dominions overseas, but the cutting of rates by wireless telegraphy and the possibilities of serious and costly interruptions in cables must be considered in connection with the question of an Imperial cable.

Sir Rider Haggard (another Commissioner) asked the witness whether he thought there was a possibility of wireless telegraphy altogether superseding cable telegraphy. The witness said he was not an expert in wireless telegraphy, and he would not like to reply. He considered that the present position of wireless was an argument against a State-owned cable.

THE FIRST PUBLIC TELEGRAPH OFFICE

WE learn from the *Telegraph and Telephone Age* that a bronze tablet, 16 by 30 inches, designed by Henry Bacon, the eminent New York architect, to mark the site of the first public telegraph office in the United States, has been placed on the wall of the old Post Office Department building, on Seventh Street, N.W., between E and F, in Washington, D.C., and was dedicated recently. Representatives of Congress, the Treasury Department, Post Office Department, and of the District Government took part in the dedication ceremonies.

The inscription on the tablet reads :—

> "Samuel F. B. Morse, artist and inventor, opened and operated on this site, under the direction of the Post Office Department, the first public telegraph office in the United States, April 1st, 1844. 'What hath God wrought.'"

Captain de la Garde, of the Military Aviation Centre at Rheims, was killed on November 11th at Villacoublay. He had just flown from Rheims, carrying out wireless telegraphy tests, and was on the point of landing when his monoplane fell headlong.

* * *

Wireless has proved its value in the case of minor difficulties, as well as in great disasters at sea. On the voyage, which ended on October 9th, a fireman aboard the C.P.R. liner *Monmouth* became seriously ill. As the ship carried no surgeon, Capt. Griffiths instructed his wireless operator to get in touch with a ship which did carry a doctor. Soon the Allan liner *Hesperian* responded, whereupon details of the sufferer's symptoms were telegraphed to the doctor, and a prescription received in return. This was repeated daily while the two ships were in touch. Later the *Montezuma* was picked up, and the "absent" treatment continued by the surgeon aboard her. The patient probably owes his life to the medical service thus given.

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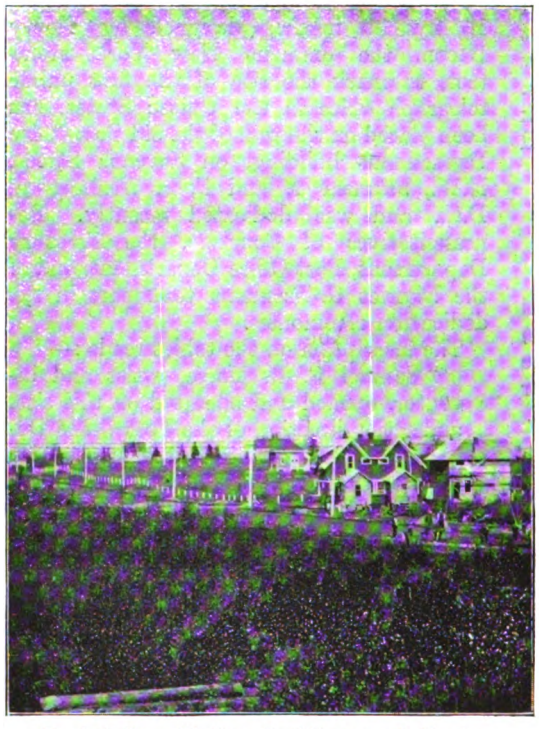
The Great Lakes Wireless Chain

FROM PORT ARTHUR TO THE ATLANTIC. DEVELOPMENTS IN WESTERN CANADA.



Port Arthur Station Buildings and Masts.

VIOLENT storms are reported to have occurred on the Great Lakes of Canada during the past month, and, although at the moment of writing we do not know to what extent wireless telegraphy has mitigated the disastrous consequences of the furious storms, we may be sure that one at least of the stations that stand sentinel on the shores of the Great Lakes—Port Arthur—has played no unimportant part.

Port Arthur, which was formerly known as Prince Arthur's Landing, is situated in the Thunder Bay District, Ontario, on Lake Superior, and although the population is relatively small, the town has become prominent as a shipping centre for lumber and minerals from the surrounding district, and vast quantities of grain from the farther west.

The wireless telegraph station is controlled by the department of the naval service. It was recently remodelled and has been equipped with modern plant by the Canadian Marconi Company. The new masts are of wood each 185 feet high. The transmitting apparatus is in duplicate, and consists of the standard 5½ kw. set as installed at the other Great Lakes stations. Each set can be driven by either a 10 h.p. 3-phase induction motor or an 8 h.p. horizontal slow speed gasoline engine. The station is arranged to transmit wave-lengths from 600 to 1,600 metres, and to receive over a similar range. The work of remodelling the station has just been completed and taken over by the Canadian Government, and the old station building is now being transformed into a residence for the operating staff. The station communicates with Sault Ste. Marie, Ont., a distance of 250 miles. Communication can be effected by means of the 600 metre wave, but better results are obtained on 1,600 metres.

Other stations at Toronto, Kingston and Port Burwell have been erected, and with their completion during the past autumn Canada possesses what is probably the largest single stretch in the world covered by wireless telegraph stations. The entire chain extends from Port Arthur to the Atlantic, so that navigation over the whole St. Lawrence system, a distance of over 2,000 miles, will be under wireless control.

The enterprise of the Government has given rise to an interesting development, which seems to have many possibilities in a country such as Canada.

* * *

It is stated that several applications have

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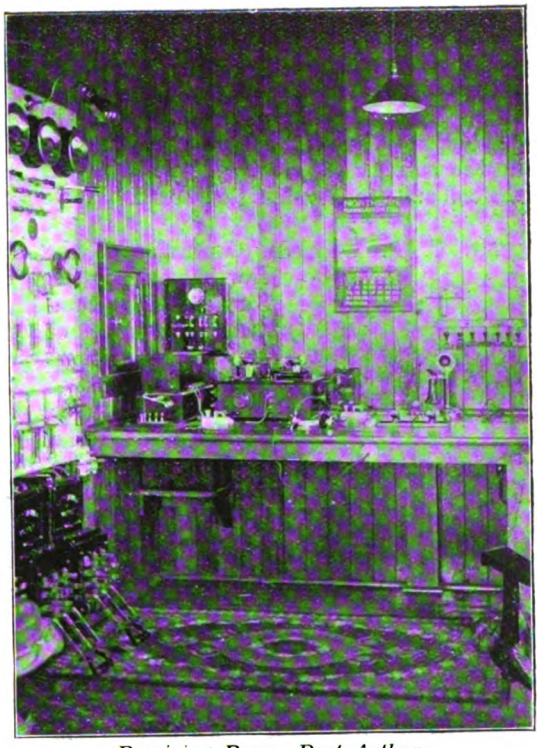
been received by the Naval Service Department from commercial firms in outlying parts of British Columbia for licences to instal small wireless stations which could communicate with the Government chain, and thus have access to the outside world.

On Queen Charlotte Islands the two stations are being connected with the interior by telephone lines. There is no cable service between the Queen Charlotte Islands and the mainland, and the new telephone connection will now give the residents of the interior of the islands telegraphic communication with the mainland.

* * *

Mr. Ridges, who was recently transferred from the Canadian Marconi Company's technical staff to a position with the Wireless Telegraph Department of the Canadian Government, is expected to return shortly from a voyage to Hudson Bay on the *Beothic*, where he has been looking over the ground in connection with a chain of stations for Hudson Bay which is under consideration by the Government.

* * *



Receiving Room, Port Arthur.

The Canadian Marconi Company have been instructed by the Government to modernise the wireless apparatus on the C.G.S. *Montcalm*, *Lady Grey* and *Druid*, and to instal sets on the *Lurcher* Lightship, near Yarmouth, N.S., and also on the C.G.S. *Simcoe*, all of which vessels are controlled by the Department of Marine and Fisheries.

Exterior of Operating House, Port Arthur.

The *Montcalm* is an icebreaker, and was fitted as far back as 1905 with a coil set. The Government, however, decided to have the vessel fitted with modern apparatus, and a ½ kw. set will be installed, the coil set being retained on board as emergency gear. The *Montcalm* is engaged in the maintenance of the St. Lawrence Channel, and her headquarters are at Quebec.

The *Lady Grey* was also fitted with a coil

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set about two years ago. The headquarters of this icebreaker are at Sorel, some 30 miles below Montreal, and she does duty during the summer maintaining the Channel between Montreal and Quebec, and assists in opening the Channel with other icebreakers in the spring. A ½ kw. set will be fitted, the coil set also remaining on board.

* * *

Mr. C. P. Edwards, Controller of the Dominion Wireless Service, has commenced a tour of the wireless stations on the West Coast of Canada. This new branch of the Government service has this year shown a considerable increase, and further developments are anticipated on the return of Mr. Edwards, whose tour will extend over six weeks.

Mr. C. P. Edwards.

* * *

The *Druid* was fitted about three years ago with a coil set, and will now receive a ½ kw. This vessel acts as a supply ship on the St. Lawrence, and is used for the maintenance of buoys, fog signals, etc., on the river.

The *Lurcher* Lightship is stationed about 20 miles from Yarmouth, N.S., and will be equipped with a 1½ kw. set. It will then be able to communicate with Cape Sable on the one side and St. John, N.B., on the other.

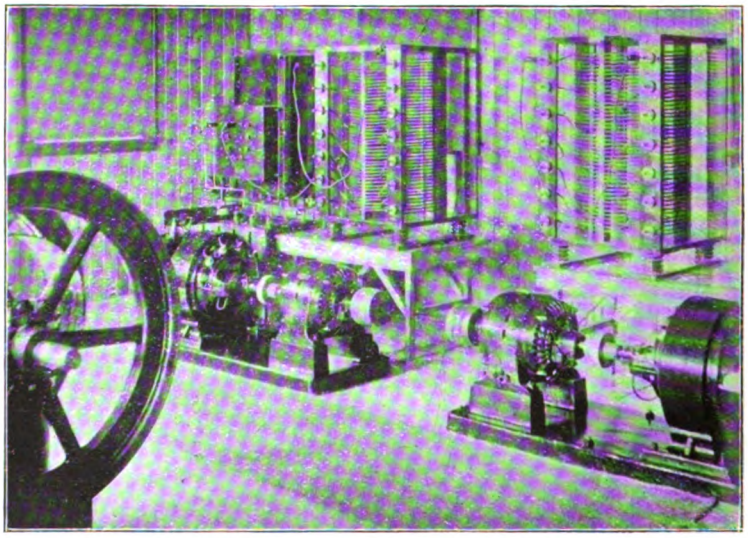
The *Simcoe* is doing duty on the Great Lakes, being used for the maintenance of aids to navigation. She will be fitted with a ½ kw. installation.

* * *

The Marconi station at St. John, N.B., was recently struck by lightning during a severe storm, being put out of commission for a few hours. The lightning played in an uncanny manner around the station, striking it three times without, however, doing any considerable damage. Other buildings in the town were also struck, but did not escape so lightly, and several fires ensued, the lightning in the case of the station being conducted to earth by the aerial wires.

The effect of the lightning on the station was to fuse the aerial wires, and some slight damage was done to the transmitting apparatus inside the station.

An unusual phenomenon was reported on November 7th by a Canadian Pacific Railway train "dispatcher." The work of dispatching is done by a telephone, and while listening at his instrument, the "dispatcher" picked up regular dashes and dots of the Morse code, and as he was an expert telegraphist he could follow the message, which was a wireless communication from some vessel at sea announcing her approaching arrival at San Francisco. Apparently the telephone wires had acted as an aerial. The name of the ship is not known, as only her code number was signalled. Wireless operators and telegraphists here are very much interested in the occurrence.



Transmitting Room, Port Arthur.

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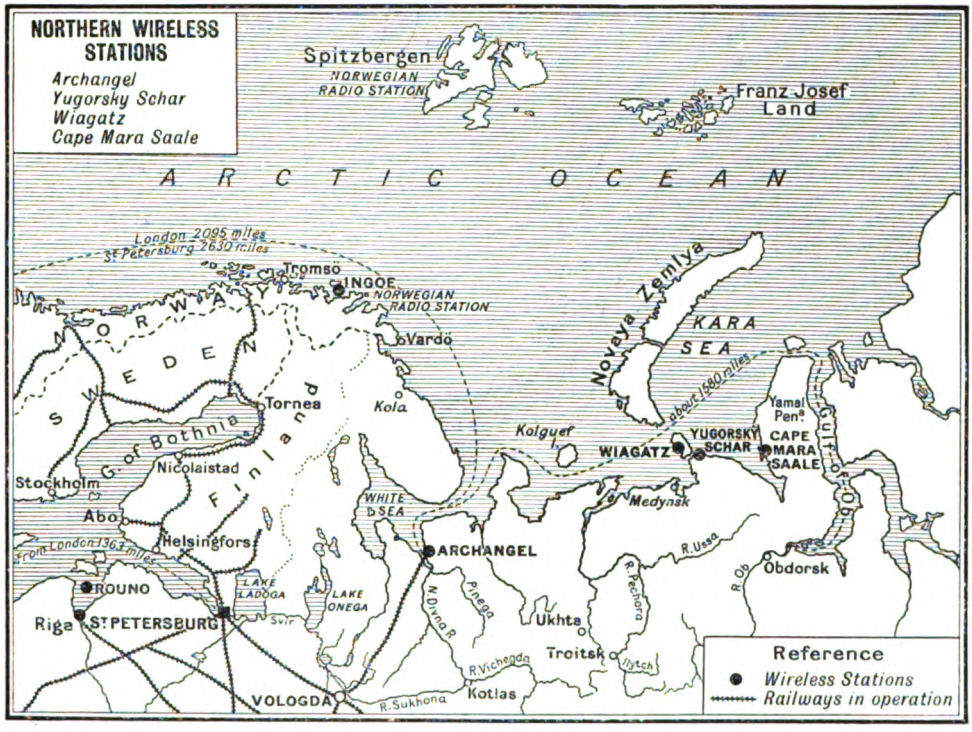
The Development of Wireless in Russia

Opening of the Northern Route



THE development of wireless telegraphy within the Russian Empire has been followed with considerable interest. Those who are acquainted with the Russia of to-day know what splendid opportunities that country offers, and it is almost unnecessary to point to the close association of wireless telegraphy with the development of the limitless resources of the empire. The progress of the Russian Wireless Company during the past year is eloquent testimony to the fact that the Government are fully awake to the possibilities ahead. In 1912 a number of large and important orders were placed with the company, both for the erection of shore stations and the equipment of the Russian Marine. Thirty-six ship stations of the Russian Navy were converted by the Russian Company of Wireless Telegraphs and Telephones, and among the company's other developments in 1912 was the introduction of a special type of light, portable station for the use of the Russian cavalry. Two such stations were worked by the Imperial Hussars during the summer manœuvres of 1912 with the greatest possible success, a special demonstration of their capabilities being afterwards given in the presence of the Emperor. As a direct result of the successful trials of these stations, a Special Commission is now sitting with a

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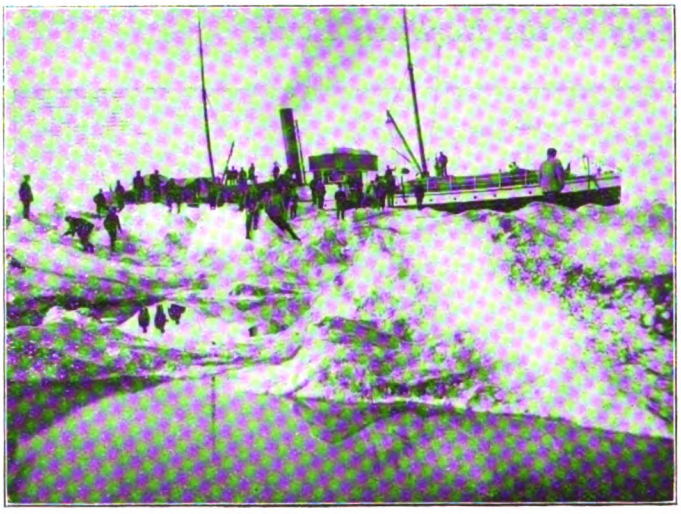
view of definitely deciding the type of cavalry station most suitable to the needs of the army, and large orders for these stations may eventually be expected.

All matters relating to wireless telegraphy in Russia are subject to an inter-departmental Committee, formed last year. The committee, which is attached to the headquarters staff of the Postal Telegraph Department, is composed of representatives from all public departments and is presided over by an official who is appointed by His Imperial Majesty the Tsar on the recommendation of the Minister of the Interior. This committee exists for the "co-ordination of the work of the various departments relating to the existence and use of the Imperial network of radiotelegraphic and radiotelephonic stations and for the consideration of schemes for the establishment and maintenance of radiotelegraphic and radiotelephonic communication which require preliminary discussion between the departments affected thereby." Incidentally, we may mention, a new law is under consideration to make it compulsory for all passenger-carrying vessels to be equipped with wireless telegraphy, so that in due course a large field should also be opened up in this direction.



The "Dan" on the way to Yugorsky Straits.

Wireless telegraphy in Russia owes its origin to the foresight and enterprise of Mr. S. M. Eisenstein, who, in 1905, laid the foundation of the present great organisation by establishing a workshop and laboratory in Kiev. He erected two stations, one at Kiev and the other at Schmerikka (about 187 miles apart), and the success of these stations encouraged him to transfer his business to St. Petersburg, where he formed a company which undertook the manufacture of apparatus as well as the erection of stations. This company, which is now known as the "Russian Company of Wireless Telegraphs and Telephones," officially commenced operations in October, 1908, and the story of its successful development describes, in a large measure, the commercial development of wireless telegraphy in Russia since that date.

Numerous orders began to come in from the military and naval departments for permanent stations and field stations. Among these may be mentioned an order from the military department for two high-power stations, at Bobruisk and Urschoomka (about 1,650 miles overland), and an order for the erection of stations at Tiflis, Kars, Brest-Litowsk, and Helsingfors, also orders for small apparatus. Soon the company found its premises on the Vassily Ostrov too small to cope with the work on hand, and it was decided to purchase land for the erection of a new building large enough to allow of considerable development. The site for the new works is in one of the most beautiful parts of St. Petersburg—on the Kameno Ostrov, about 2½ miles from the centre of the city, and we hope soon to publish a description of these works.

The development of the wireless telegraph network has been well advanced by the Government. Stations were erected at Nikolajewsk, on the Amur, and at Petropawlowsk, in Kamchatka. These were followed by stations on the Baltic coast, and others in the far east—viz., Ochotsk, Anadyr, and Nayachan, which, in conjunction with Nikolajewsk and Petropawlowsk ensure a radiotelegraphic service between the Sea of Ochotsk, the Bering Sea, and the Bering Strait.

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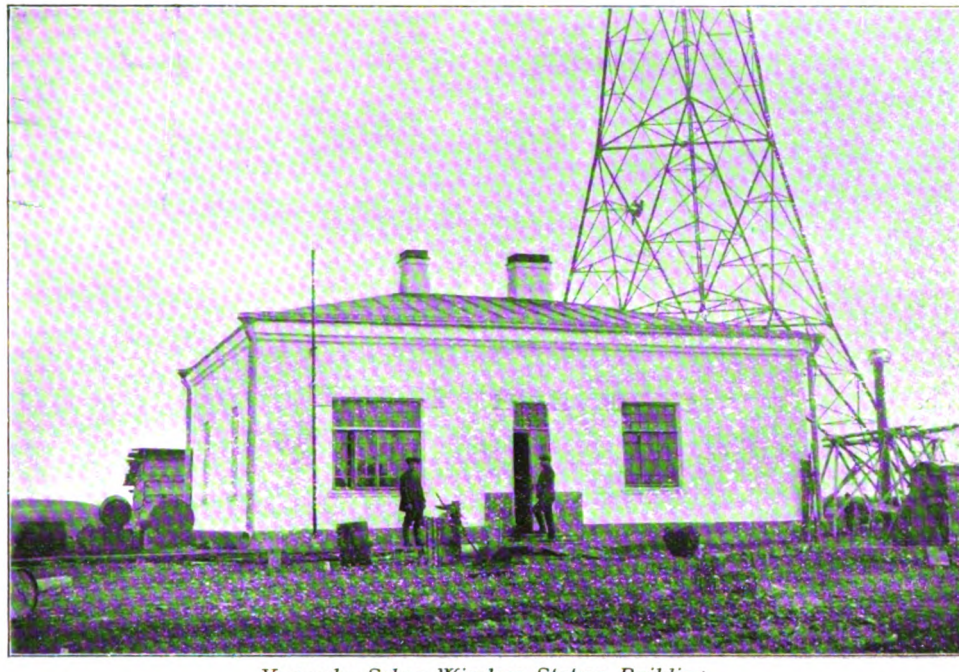
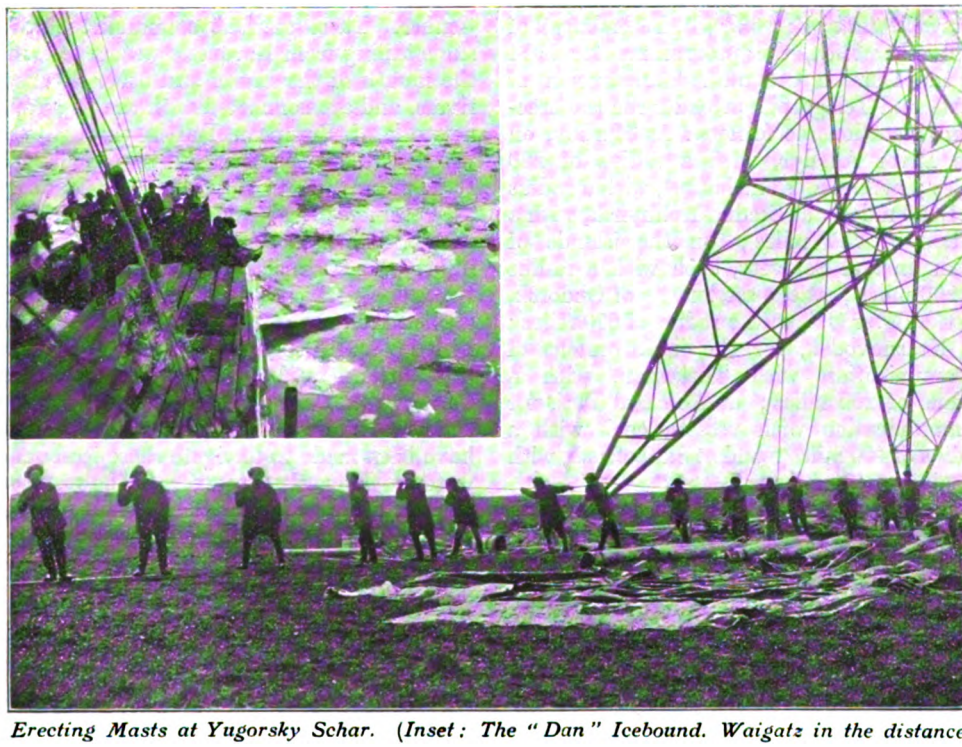


Yugorsky Schar Wireless Station Building.



Erecting Masts at Yugorsky Schar. (Inset: The "Dan" Icebound. Waigatz in the distance.)

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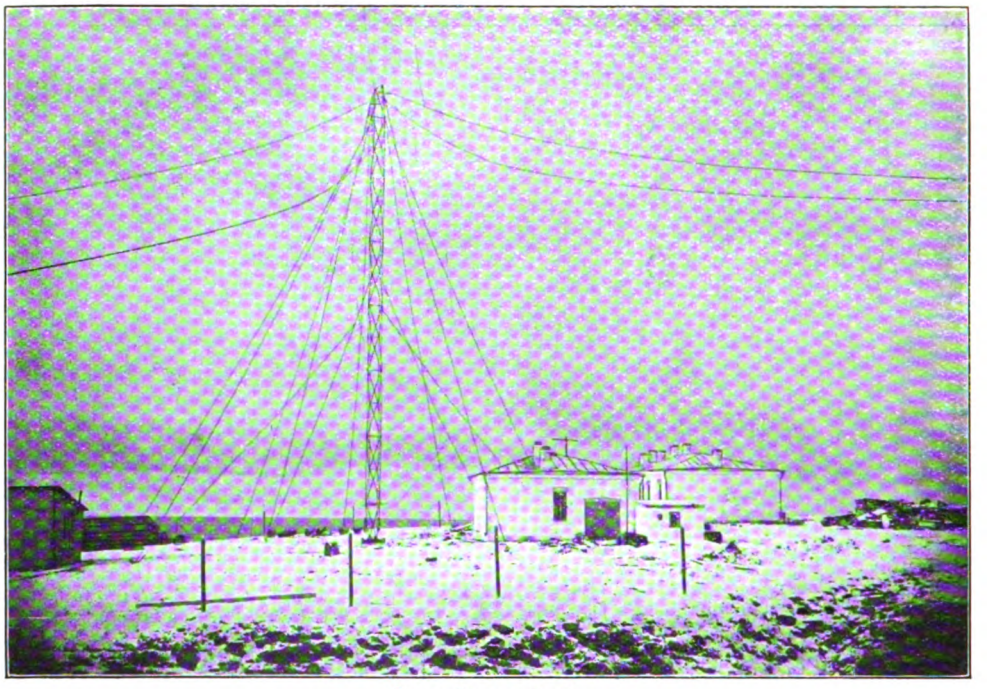

Cape Maare-Saale.

In addition to the above, according to the *Pravitelstvennei Vyestnik* (St. Petersburg) of September 19th, the programme for 1914 of the Russian Central Administration of Posts and Telegraphs provides for the erection of stations as follows: At Markov, on the River Anadyr, with a radius of 200 miles; at Tigila (Kamchatka), with a radius of 1,000 miles; at Sredne-Kolmynsk, with a radius of 535 miles; on the islands of Sakhalin and Solovetz, each with a radius of 200 miles; at the settlement of Obdorsk, on the River Obi, with a radius of 670 miles; at Krasnovodsk, for the improvement of communication with Turkestan, with a radius of 200 miles; at Abo and Poti, for communication with vessels, each with a radius of 400 miles; and at Skobolevsk, with a radius of 400 miles.

No record of radiotelegraph development in Russia would be complete without some reference to the wireless stations erected on the northern coast of the empire by the Russian Company for the Post and Telegraph Department. They are situated respectively at Waigatz, Yugorsky Schar and Cape Maare-Saale in the Kara seas, which are open to navigation during three months of the year only—July, August, and September. These stations communicate with ships sailing from European waters towards the mouth of the Enisei and other Siberian rivers, and are connected with the telegraph network of European Russia through the wireless telegraph station at Archangel. It is interesting to note that the Ministry of Commerce and Industry have invited proposals from Russians desirous of organising regular steamship traffic with the rivers Ob and Enisei. Captain R. V. Webster reopened the northern sea route in the *Nimrod* in 1911, and a successful voyage was made this autumn by Mr. Jonas Lied, in the ss. *Correct* with Dr. Nansen as a passenger.

Several more or less successful attempts have been made to navigate these ice-bound waters. Recently, however, as the result of an expedition which Captain Webster undertook in the *Nimrod* to the Kara Sea, a scheme has been provided for the running of ordinary tramp steamers between England and Nova Zembla, on the south-west of which there is a magnificent harbour, and from which goods would be transported to the Ob and Yenisei in vessels specially adapted to resist the ice pressure. It is believed that

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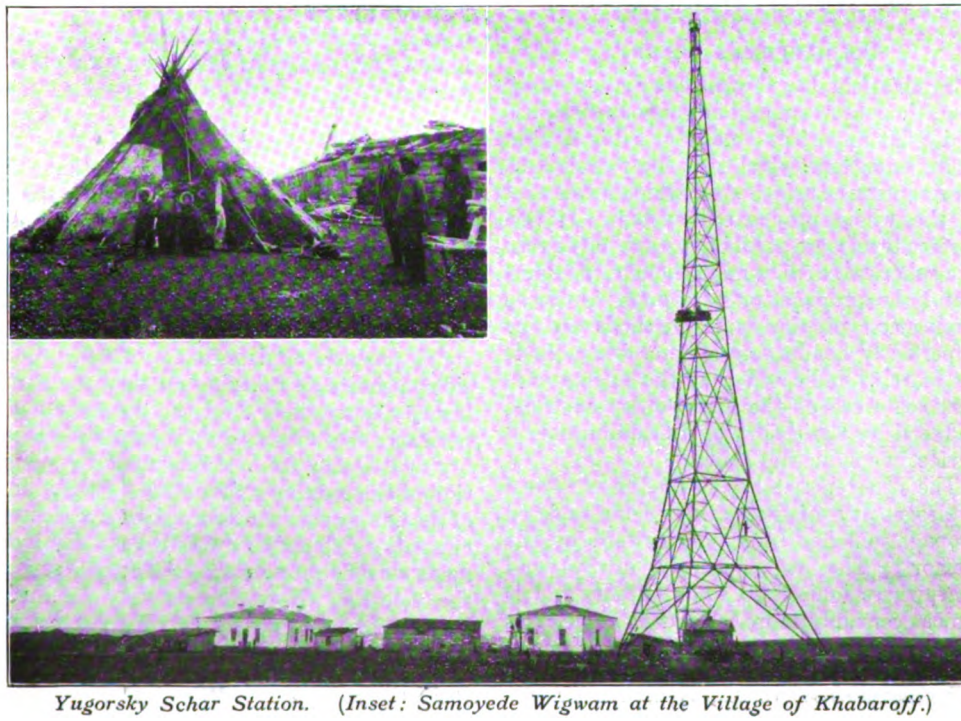
they would be able to make three voyages each way during the season that navigation is possible, and when the Kara Sea becomes blocked it is suggested that the vessels could be employed in sealing. But another point has to be considered. It is doubtful whether it could ever have become part of a practical policy without the aid of wireless telegraphy, for the dangers of the ice-bound coast are many, and the rigours of the climate retard development. Wireless, however, makes no obeisance to the elements and can brave the icy blasts of the Arctic Circle. Now, by the erection of these stations, communication will be set up by the port, and timely warning of the opening of the Kara Seas to navigation during the summer months, with regular reports as to the ice conditions prevalent, will be forthcoming.

The floating ice in the Kara Seas forms the chief peril. The Duc d'Orleans, who in 1907 undertook a cruise in the Kara Sea, has given some vivid descriptions of this dreary waste of black ice. Here is a characteristic passage :

" These ice floes, which are to be found in the centre of the Kara Seas, come from the coast of Siberia, which is low and sandy. They are formed by shingle and shells which have been covered up by snow. This has melted or been congealed by pressure into a thick mass of ice containing the silt. Again the sun and rains wash away the surface ice, and the *debris* becomes compacted into a horrible black soil. As this travels southward it is gradually broken up and diminished in thickness, until at last the whole of the ice is melted away, and the sediment sinks to the bottom to form the ooze of the Kara Sea. Though the phenomenon may be very interesting from the scientific point of view, from the picturesque standpoint it is deplorable. Nothing could be uglier or more depressing than this stretch of sea covered with heaps of dirty snow, and whenever a passing vessel dents into, or overturns, one of these lumps the sediment spreads out over the surface of the water, giving it a muddy chocolate colour. Often the ice-blocks would collect together in front of us, so that at times we could chase before us a whole bank of mud, and look very much as though we were one of those street-brushing machines which as they revolve send the immondices of big towns into the gutters."



Yugorsky Schar Station. (*Inset: Samoyede Wigwam at the Village of Khabaroff.*)

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Atmospheric Refraction in Wireless Telegraphy.

By W. H. ECCLES, D.Sc.*

IT seems to be agreed among the mathematicians who have worked at the subject, that wireless telegraph signals could not be transmitted a quarter way round the globe by means of diffraction. According to some numerical results of J. W. Nicholson, a station rated at more than a million kilowatts would be required for communication with Buenos Ayres if diffraction alone were utilised. These calculations have all been made on the supposition that the earth is a perfect electrical conductor, and that the medium surrounding it is electrically homogeneous; but these conditions are by no means fulfilled, and it has been suggested that the transmission of signals to great distances is successful either because the earth is not a perfect conductor or because the air is not a perfect dielectric.

SOMMERFELD'S THEORY.

Sommerfeld has shown that the boundary conditions between a homogeneous dielectric and a flat imperfect conductor led to a term in his equations which may be regarded as representing a surface wave which forms part of the whole propagated system. If this surface term were at all important in the case of a spherical earth, it might help us to understand the propagation of signals; but the application of the same methods to the imperfectly conducting sphere, when made by March,† indicated that the effects at a distance were of the same order as those deduced by the theory of diffraction over a perfectly conducting sphere.

The other possibility, that the electrical heterogeneity of the atmosphere assisted propagation, has been put forward by the author.‡ The atmosphere is always and everywhere ionised to some extent, and is almost certainly more ionised at high levels than at low. Some years ago Heaviside pointed out that if strong ionisation sets in suddenly at some high level then this layer would act as a reflecting envelope, and make possible the propagation of waves to the Antipodes. At night signals may travel to remarkable distances whatever their wavelength, and this suggests reflection rather than refraction; in the day signals of great wave-length travel best, which suggests refraction. The hypothesis introduced by the author, which attempts to account for this, is based on the assumption that the sun's rays ionise the atmosphere in such a way that the concentration of ions increases gradually as we ascend in the atmosphere. In this event, a ray started horizontally, say, will pursue a curved path with its concavity towards the earth; and thus, if the ionisation is great enough, an electric ray may follow and overtake the curvature of the earth.

ELECTRIC WAVES THROUGH GAS.

The fundamental theorem is that the velocity of electric waves through a gas is increased by the presence of ions of molecular size in the gas.* The velocity of long electromagnetic waves will thus exceed the velocity of light in an ionised medium. As this seems difficult of belief, the following rough physical explanation is offered: Consider a molecule carrying an electric charge in the electric field Z of the waves; it experiences an alternating mechanical force urging it to and fro. If Z is small, the direction of the motion is that of Z. The motion of the charge constitutes a convective electric current, which may be regarded as a displacement current proportional to the charge and the velocity. Now, the velocity produced by the force is nearly 90 degrees *behind*

* Read before the British Association.
† Annalen der Physik, Vol. XXXVII.
‡ "Proc." Roy. Soc., Vol. LXXXVII., June, 1912.

* Eccles, *loc. cit.*, and J. Salpeter, "Phys. Zeitsch.," 14, p. 201, March, 1913.

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the force in phase. This may be seen from the analogous fact that the current produced in a choking coil by an alternating voltage is nearly 90 degrees behind the voltage. But the true displacement current in a dielectric free from charged molecules is proportional to $\kappa dZ/dt$, where κ is the permittivity and t is time. From the analogy with the current produced in a condenser by an alternating voltage, we see that this true displacement current is about 90 degrees *in front* of the voltage in phase. Thus the displacement current due to the ions is opposite that due to κ—that is to say, the ions produce in effect a reduction of κ. This involves an increase of the velocity of the waves. The amount of the increase depends on the amplitude of motion of the molecules as well as on the phase.

The mathematical law according to which the ionisation increases as we ascend in sunlit air is quite unknown. Nevertheless, it is of interest to examine the trajectory of rays in an atmosphere obeying an assumed law. The problem of the rays in a medium disposed in concentric spherical shells of continuously varying refractive index is a familiar one in optics. If μ be the refractive index at any point, P, of the path at a distance, r, from the centre of the sphere, and p the perpendicular from the centre O on the tangent to the trajectory at the point P, then the sine law of refraction yields the equation,

$$\mu p = \text{constant}.$$

The constant is $\mu_0 p_0$ when the symbols refer to the starting point A of the ray on the earth's surface. Let θ represent the angle POA, then the above equation becomes

$$d\theta = -\frac{\mu_0 p_0 dr}{r\sqrt{\mu^2 r^2 - \mu_0^2 p_0^2}}.$$

When μ depends solely on r, and is one of a limited number of functions of r, θ can be expressed in terms of r by elementary integrals.

As a simple example, suppose $\mu = a/r^{n+1}$ for distances extending to a few hundred miles from the surface of the earth. Let R be the radius of the earth and ζ the zenith angle of a ray starting at any point, A, of the surface. Then integration gives for the polar equation of the ray

$$r^n \sin\zeta = R^n \sin(n\theta + \zeta),$$

and the ray reaches the earth again at the point given by

$$\theta = (\pi - 2\zeta)/n.$$

By following the paths of two consecutive rays in a plane the energy flux-density through the medium at any point of the trajectory can be compared with that at a standard distance from the source. The points of interest to us are on the surface of the earth. Taking two consecutive rays at the angle ζ, the elementary area cut off on the unit sphere by rotating the rays about the vertical is $2\pi \sin\zeta\, d\zeta$, and that cut off on the orthotonic surface at the point (R, θ) is $2\pi R \sin\theta \sin\zeta dz$. Let W_1 be the energy flux density at the unit distance when $\zeta = \frac{\pi}{2}$; then, by Hertz's equations of the field of a radiator, the flux-density at any angle, ζ, is $W_1 \sin^2\zeta$. Hence, if there are no losses by absorption in the medium,

$$W_1 \sin^2\zeta \cdot 2\pi \sin\zeta(-d\zeta) = W \cdot 2\pi R \sin\theta \sin\zeta dz,$$

where W is the energy flux-density at any point of the trajectory. Near the earth's surface we have, by geometry,

$$\frac{d\zeta}{dz} = \frac{\tan\zeta}{R}\frac{d\zeta}{d\theta}.$$

Therefore

$$\frac{W}{W_1} = -\frac{\sin^3\zeta}{R^2 \sin\theta \cos\zeta}\cdot\frac{d\zeta}{d\theta} = \frac{n}{2R^2}\cdot\frac{\cos^3\frac{1}{2}n\theta}{\sin\theta \sin\frac{1}{2}n\theta}.$$

The wave fronts near the receiving station make an angle, ζ, with the horizontal there, and therefore a vertical antenna absorbs energy per unit length at a rate proportional to $W \sin^2\zeta$. [A horizontal antenna would absorb at the rate $W \cos^2\zeta$]. Hence the rate of absorption of energy may be written

$$W = \frac{nW^1}{2R}\cdot\frac{\cos^5\frac{1}{2}n\theta}{\sin\theta \sin\frac{1}{2}n\theta},$$

where W and W^1 may be supposed measured in watts. Let us take $n = 2{\cdot}6$ [which from other considerations corresponds to a wavelength 5·4 km.] and the standard distance 520 miles, corresponding to $\theta = 7\frac{1}{2}$ degrees; then the value of W at distances corresponding to $7\frac{1}{2}$, 15, 30 degrees are in the ratios

$$1 : 0{\cdot}103 : 0{\cdot}0107.$$

This may be compared with the results of

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the empirical formula given by Austin and Cohen,* which may be written

$$W = W_1\left(\frac{s_1}{s}\right) / exp\left(\frac{2a(s-s_1)}{\sqrt{\lambda}}\right),$$

where s represents the distance measured along the earth's surface from the sender to a moving receiver, and s_1 that to a stationary receiver at the standard distance.

Austin and Cohen give the value of a as 0·0015, the distance being in kilometres. With $\lambda = 5{\cdot}4$ km., the ratios of power absorbed are

$$1 : 0{\cdot}087 : 0{\cdot}0028.$$

These differ very considerably from those calculated above; but, obviously, the law assumed for the variation of μ with r is only very roughly representative of the probable state of affairs in the atmosphere. Moreover, the absorption has been supposed nil.

A more plausible law to connect μ and r is given by

$$\mu^2 = \mu_0^2 \frac{R^2 + 2Rz - az^2}{(R+z)^2},$$

where $z = r - R$, and is therefore height above the earth's surface, and a is a positive constant dependent upon the wave-length. This law makes the index of refraction fall very slowly near the surface of the earth and more rapidly later, till at a certain height μ vanishes, or the air becomes a perfect conductor. The solution is too cumbrous to reproduce here, but the range of a ray reduces to

$$\theta = \frac{\sin\zeta}{\sqrt{1+a+\sin^2\zeta}}\left(\pi + 2\sin^{-1}\frac{\sin^2\zeta}{\sqrt{1+a\cos^2\zeta}}\right).$$

The characteristic feature of the trajectories under this law is that the ray starting horizontally has the longest range; rays starting at increasing elevations have their vertices at diminishing distances. This crossing of the rays leads to the formation of caustics and of rough foci, which have never been observed in the history of wireless telegraphy. To estimate the energy density at any point it becomes necessary to take into account the reflections from the earth (or sea) of the rays of high elevation and short trajectory, and this is very laborious. These characteristic features of the rays probably appear in all cases where the upper layers are assumed to become very conductive. There is more hope of obtaining calculations which shall fit in with experience by assuming a law of variation of refractive index more in accord with Schuster's views of the electric state of the atmosphere, as found by him necessary to account for the diurnal variations of terrestrial magnetism. The author is, therefore, working out a case in which the refractive index first decreases with increase of height above the earth and then asymptotically approaches a limiting value corresponding to the conductivity of space. It may be remarked, by the way, that if space is, as suggested by Schuster, in some degree conductive, long electric waves should travel faster than light waves from the sun to the earth.

In concluding this account of the simplest method of attacking the problem of refraction of electric waves round the earth, it is convenient to point to a matter of some theoretical importance in connection with the Austin-Cohen empirical formula. This formula being of the form

$$w \propto \frac{1}{s^2}\epsilon^{-As},$$

where w is the power absorbed by a receiver at arcual distance s, and A is a constant (dependent on the wave-length), appears to be interpreted in some quarters as indicating that energy spreads round the earth according to an inverse square law, and is afflicted by absorption of ordinary optical type, as indicated by the exponential. But it is, at least, very unlikely that in the absence of absorption an inverse square law would be followed by waves creeping round the globe, and therefore we suppose that the form in which the formula has fallen is largely accidental, as is so often the case with empirical formulæ. The calculations given above indicate that if a suitable mathematical law of variation of refractive index could be assigned the fall of intensity of signals with distance might be accounted for numerically without any absorption whatsoever. Something rather less extreme than this is, however, to be looked for, since formulæ that have been deduced for the absorption in highly ionised air * prove that some absorption is to be expected in the case of rays traversing the higher levels of the atmosphere.

* "Bull." Bureau of Standards, No. 3, 1911, and J. L. Hogan, *The Electrician*, August 8, 1913.

* Eccles, *loc. cit.*, and O. J. Lodge, "Phil. Mag.," June, 1913.

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Wireless and Weather.

By A. H. TAYLOR.

[This article has been reproduced from the "Electrical World" of New York, and it invites further speculation as to the explanation of the connection between absorption and cloudiness. Professor Taylor suggests that the absorption is atmospheric, and that it is caused by the sun-created conductivity close to the earth's surface (below the normal cloud layers).]

IT is a well-known fact that the night range of a long-distance wireless station is often several times as long as the day range. It is also a matter of common experience that the day range and the night range are both subject to wide variations from day to day or night to night. Reference is not here made to variations attributable to unfavourable conditions at the sender or at the receiver, such as excessive atmospheric electricity, heavy rains with consequent poor insulation, or interference with other stations, but rather to variations that may be traced to general absorption over long stretches of land or sea.

There must be a vast quantity of data on hand bearing on this problem, as every operator must have noticed some connection between transmissivity and weather, but the data are scattered and not readily available. The writer is not aware that any serious attempt has been made to correlate the transmissivity over long distances with the weather conditions prevailing in the region traversed by the waves. There seems to be only one tenable theory as to the source of this absorption, and that is the sunlight theory mentioned by Zenneck, Pierce and others. Ionization of upper layers of the earth's atmosphere by the ultra-violet rays of the sun is supposed to develop a slightly conducting medium which would account for the absorption.

If this is true, it might reasonably be expected that on a night following a day which has been sunny over a long stretch of country between any two stations, the transmissivity would be low, while if cloudy conditions prevail over the same area the transmissivity would be high. On the other hand, it may be urged that the ionization occurs in regions above the clouds, and that no connection between transmissivity and cloudiness should be expected.

There are few stations in this country more favourably situated for the investigation of the problem of absorption over land areas than the radio-electric station of the University of North Dakota, situated, as it is, in Grand Forks, just 1,200 miles from each coast, and within easy reach of the lake district. The aerial is of the inverted L type, 12 ft. wide, 130 ft. long, and 80 ft. above the ground. An audion receiver, used with a loose-coupler and suitable tuning condensers, has been found to be the most sensitive for long distance work. The audions used were operated at a fixed current value somewhat less than the value necessary for maximum efficiency. This heating current was in all cases not far from 0.32 amp. The sensitiveness of an audion receiver was tested frequently by means of a standard test buzzer circuit, adjustable to any desired wave-length and damping. The applied voltage on the telephone circuit was varied so as to keep the sensitiveness at nearly the same value through a series of tests.

It was not possible to obtain United States Weather Bureau maps on the day preceding the test, but through the courtesy of Prof. Simpson, director of the University of North Dakota weather station, it was possible to get the maps on the day following the tests. This had one advantage, namely, that the observer was unprejudiced by any preconceived notions as to the bearing of the weather on results.

On February 24th the author listened between 7 p.m. and 11 p.m. and heard signals from the University of Michigan, at Ann Arbor, when 3.4 kw. was employed, as

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a subsequent letter from Mr. H. S. Sheppard, in charge of that station, indicated. Signals from some ten or twelve other stations along the Atlantic coast were also plainly heard.

It must be noticed that at this distance from the coast, and with a moderately high aerial (80 ft.), coastal stations and ocean vessels are heard only under rather favourable conditions for transmission.

A glance at the weather forecast for Monday morning, February 24th, shows two large cloudy areas moving over the northern part of the United States. This map also shows a clear area some 500 miles wide between the University of Michigan and the University of North Dakota. The test with the University of Michigan station was even more remarkable for the fact that the signals from the University of North Dakota stations were heard faintly at Ann Arbor when calling with 1 kw. This test is the only one so far in which good transmission has been noticed to follow clear weather conditions, and even in this case it is seen that the whole Atlantic coast lay within a cloudy area, which extended to the westward beyond Michigan.

On Sunday, March 2nd, the author was not at the station, but Mr. E. C. Reinecke, an amateur at Fargo, N.D., reported a very good night. Mr. Reinecke thought he heard signals from Colon, Panama, on that evening. A map for Sunday is not sent out by the Weather Bureau, but the map for Saturday, March 1st, shows a general cloudy condition all along the Atlantic coast, and from the Gulf to Winnipeg. The map for Monday shows very cloudy conditions prevailing throughout the Mississippi Valley, and lake district, and the North-west. The indications are, therefore, that Sunday was pretty generally cloudy, and both Saturday and Monday maps show general cloudiness in the area between Fargo and Key West. Whether this condition extended as far as Colon or not I am unable to say. It seems very likely.

On the evening of March 4th we were able to hear signals from the stations from both coasts, and Key West signals were received at the university, and also at Fargo. The weather map for that day shows cloudiness all along the line between Grand Forks and Jacksonville, Fla., and the following day's map shows that this condition moved on down beyond Key West. The map for March 4th shows a cloudy belt to the northwest, toward Seattle and Vancouver, while the whole Atlantic coast is likewise cloudy.

The night of March 13 was one of the best as regards the number of stations from which signals were heard, but the excessive static electricity prevented any but a good operator from recognising many calls. I have no hesitancy in saying, however, that more stations were heard from that night than on almost any other. The weather map for March 13th shows cloudiness everywhere except in the south-west.

The next test was made on March 17th, and practically no signals were heard between 8 p.m. and 11 p.m. The map for March 17th shows all the Eastern part of the country in a clear area. The connection seems to be obvious.

On the next evening the author thinks he identified three calls from the Pacific coast, near Vancouver and Seattle. It may have been a coincidence, but the map for the 18th shows a cloudy area between Grand Forks and Seattle, while the Eastern coast is clear. This seems to explain why signals from no Eastern stations were picked up that night.

The map for the 18th seemed to indicate that the cloudy conditions would proceed eastward. Acting on this hypothesis the author spent the evening of March 19th at the station, expecting to catch signals from many Eastern stations. Much to his surprise not one was heard. Next morning, when the map arrived, it was seen that the cloudy condition had turned and swung down South through the valley of the Mississippi, and that the East had remained clear. This seems to be rather definite evidence that cloudiness and transmissivity are directly connected.

It should have been noted in connection with the test of March 17th, when no signals were heard, that Michigan called us by pre-arrangement at definite intervals, using from 4 kw. to 8 kw., but we were unable to hear anything.

On Monday, April 21st, the University of Michigan called several times, and was heard very distinctly at the University of

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North Dakota, although the static disturbances were very bad. No Eastern stations were heard, but signals from several in the lake district came in very strong. The weather map shows a cloudy area between Winnipeg and Chicago, but a clear region along the Eastern coast. On the following evening the author listened at the receiver between 8 and 9.30 o'clock with no result. The Michigan station did not operate for our benefit that evening, but I should have been able to hear signals from any lake stations if they had operated in that interval, if the cloudy area in that district, as shown by the April 22nd map, has any bearing. The Eastern coast remained clear.

On Wednesday evening signals were heard from the University of Michigan station, several stations in the lake district and several on the northern Atlantic coast. The Wednesday map shows a cloudy area over all of this territory. On Thursday, April 24th, Mr. Reinecke, at Fago, reported hearing signals from a number of stations with great distinctness, an observation which was checked at the University of North Dakota station. The map for this day also shows a cloudy area in the lake region.

It would be possible to multiply greatly these instances of the connection between cloudiness and transmissivity, as I have made many random observances after sunny days of the early winter, when signals from very few stations were held, and more often none at all. So far, of some thirty observations, I have found only two which do not clearly indicate that a general daytime cloudiness over a wide area is sure to be followed by an evening of high transmissivity. It still remains to be shown whether cloudiness at transmission station or at receiving station is more effective, although I am inclined to think that the transmissivity is better when the sunny area, if there is such, affects only the receiving station and its neighbourhood. The transmissivity is even then not so good, of course, as it is when the cloudy area includes both the receiving and the sending stations.

If the connection between cloudiness and transmissivity be conceded, it will be apparent that the general atmospheric absorption does not occur in the regions above the clouds to anything like the same extent that it does in the regions of lower level, which is contrary to previous speculations on this point.

It would also appear that far Northern stations operating in summer when the period of sunshine is of long duration should have a shorter range than in winter. It would be of interest to know if the operators of Alaskan and Northern Canadian stations have any data bearing on this point. With the collection and correlation of more data on radio-transmission and meteorological conditions, doubtless some of the vagaries of wireless experimentation will be accounted for, and might even be put to practical use by the weather bureau.

STRENGTH OF SIGNALS.—In the *Elektrotechnische Zeitschrift* Mr. H. Mosler gives an account of an investigation extending over a year, in which the receiving intensity of a station at a distance of 425 kilometres (255 miles) was measured day and night. He found that during the day the receiving intensity was not influenced by the height of the sun, or in other words was constant during the whole year, but during the night there were characteristic maximum peaks in autumn and spring. The receiving intensity was particularly increased for short intervals in the night during a cold season, and this is probably due to the changes in the ionisation phenomena in the upper atmosphere; effects of moonlight were not observed by Mr. Mosler.

* * *

CORRECTION.—A correspondent writes: "On page 487 of the November WIRELESS WORLD, dealing with the theory of electromagnetic waves, you state: 'If i be the root-mean-square current at any point, the voltage drop per centimetre at that point will have a R.M.S. value of ωLi, where $\omega = 2 \sim$, and will be 90° out of phase with the current.' Is this quite correct, and should it not be $\omega = 2\pi \sim$?

"I should like to say how much I enjoy your splendid paper; it is a pleasure which I look forward to month after month. Thanking you for the instruction received from THE WIRELESS WORLD."

[Our correspondent is quite right in his correction.]

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Safety at Sea

INTERNATIONAL CONFERENCE IN LONDON. WIRELESS TELEGRAPHY. MR. BUXTON PAYS TRIBUTE TO THE INVENTIVE GENIUS WHO HAS RENDERED EFFECTIVE THIS GREAT DISCOVERY.

THE International Conference which is considering the safeguarding of life at sea was opened in London on November 12th by the President of the Board of Trade, the Rt. Hon. Sydney Buxton, M.P. The Conference owes its origin to the anxiety and distress which was occasioned by the startling and sudden destruction of a liner last year, and it is invested with additional importance by the tragic occurrence in mid-Atlantic a few weeks ago. It is the German Emperor who suggested, on the morrow of an unforgettable disaster, that the representatives of the nations should meet, in order to "establish conclusions from the cruel lessons furnished by the catastrophe." His Imperial Majesty's appeal was generally welcomed, and from the first the British Government declared itself ready to undertake preparations.

The London Conference, which is holding its meetings at the Foreign Office, is essentially a conference of practical men representing nearly all the peoples who use the seas. It is engaged upon the consideration of regulations as to the construction of ships, the character of the life-saving apparatus to be carried, and the conditions under which ocean navigation should be conducted. If their deliberations should result in the drawing up of workable regulations which will be enforced by each of the Governments, the foundation will have been laid of a great humanitarian movement, which may rob the sea of many of its terrors.

In the light of recent events public interest will undoubtedly centre in the possibility of further extending the use of wireless telegraphy in the service of mankind. The subject figures prominently in the Conference agenda, and some idea of the value of this invention as a means of saving human life was reflected in Mr. Buxton's tribute "to the inventive genius who has rendered effective this great discovery." As the realisation of humanity's debt to wireless telegraphy increases we are brought nearer to the fulfilment of the prophecy of the leader-writer in the *Daily Telegraph*, who wrote: "Mr. Marconi may never come into the heritage which he has won by his achievement; but the day will arrive when his name will be uttered with those of Jenner, Lister and the other great benefactors of the human race."

The Conference was opened by Mr. Sydney Buxton, who was accompanied by Mr. J. M. Robertson (Parliamentary Secretary to the Board of Trade), and Sir H. Llewellyn Smith. In his address Mr. Buxton outlined the scope of the Conference, and indicated the questions to be discussed, which he divided broadly into five heads:—

(1) Is it possible by constructional arrangements to decrease or to eliminate the liability to founder? I have in mind more especially bulkheads and watertight compartments.

2) In the event of collision, fire, (or other accident, what apparatus and machinery are required to minimise the disaster and to save the lives of those involved? This head covers the provision of boats and their accessories, and of other life-saving appliances, of fire extinguishing appliances, and other apparatus into the details of which I need not enter.

(3) And equally important—What are the best arrangements to ensure the organised use of these life-saving appliances, so that they can be most effectively, coolly, and expeditiously handled on board the ship herself, and on board a rescuing ship as well?

(4) How can aid and assistance from another ship, or from the shore, be most quickly and effectively invoked and

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obtained? Under this head I especially have in mind wireless telegraphy—a question of vital importance. I should in this connection like, on your behalf as well as my own, to pay a tribute to the inventive genius who has rendered effective this great discovery.

Finally, what measures, apart from the vessel itself, can be taken to diminish or avert the likelihood of accident? Under this heading come the observation of ice in the North Atlantic; the patrol of the ice regions in those waters; the observation and reporting of derelicts; storms and fog-signals and warnings, etc.

The Right Hon. Sydney Buxton (on right) and Sir H. Llewellyn Smith on their way to the opening of the Conference. Sir H. L. Smith presided over the International Radiotelegraphic Conference in London last June.

The King sent a message of greeting to the delegates, telling them that he takes a special interest in the subject of their discussions, and pointing out that, as a sailor, he has had personal experience of many of the matters which will come before them. The delegates were afterwards welcomed on behalf of the Government by Sir Edward Grey. Lord Mersey, the principal British representative, has been unanimously chosen as president of the Conference.

Before they dispersed, the delegates were entertained to luncheon at the Foreign Office, Sir Edward Grey presiding. In reply to the Chairman's welcome, M. Guernier, the chief French delegate, said: In the name of the delegates of the Governments which are supporting the Conference, I beg you to accept our thanks for the courtesy and affable cordiality with which you have received us. When the Government of his Britannic Majesty invited the maritime Powers to attend a conference for the purpose of finding a means of at least diminishing the disasters of the sea, its words found an echo which was all the greater because they appealed to the most noble of the sentiments which do honour to humanity. For centuries the cries of distress uttered by those in peril on the seas have been lost on deaf or indifferent horizons. But now a mysterious voice, the child of science and of daring, defies infinite space, and reminds navigators of the great lesson of solidarity. Sometimes, alas! they arrive too late. Therefore it is necessary that at all costs shipwrecked people should be provided with means for awaiting the opportune hour in order that the work of rescue should embrace everybody. That is the problem which the Conference will apply itself to solve in as complete a manner as possible.

The delegates were entertained to dinner by the Government on November 18th, and a large and distinguished company was

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Commander F. G. Loring (Great Britain), Inspector of Radio-Telegraphy to the Post Office.

invited to meet them, among the guests being Mr. Marconi.

The Lord Chancellor, who was the chief speaker, referred to the scientific aspect of the conference. Looking back over a period of little more than half a century, he was particularly impressed by the contributions which had been made by all nations to pure science. It was made clear that the country which failed to produce men great in abstract science must fall back in the race of progress. Those were the men whom the world would best bear in mind and honour—the men of science whose discoveries could be applied to practical affairs, to such work as the conference had met to do.

The Hon. J. W. Alexander (United States), who replied to the toast, said his country felt deeply indebted to Mr. Marconi for the discovery of wireless telegraphy, and was one of the first to seize upon it.

Hon. F. T. Chamberlain (United States of America), Commissioner of Navigation.

The following is a list of the delegates :—

AUSTRALIA.—Captain R. Muirhead Collins, C.M.G.

AUSTRIA-HUNGARY.—Baron George de Franckenstein ; Austria—Dr. Paul Schreckenthal, M. Pierre Fragiacomo, M. Wilhelm Palm ; Hungary—M. Ladislas Dunay, M. Andor Steinacker, M. Etienne Machay,

BELGIUM.—M. E. A. Pierrard, M. Ch. le Jeune, M. L. Franck ; Assistant Delegate, M. J. de Ruelle ; secretaries, Commander A. Bultinck, M. J. Hostie, M. E. Bogaert ; assistant secretary, M. R. Capelle.

CANADA.—Mr. Alexander Johnston ; consulting experts, Mr. Frank McDonnell, Mr. Charles F. M. Duguid, Major H. Maitland Kersey, D.S.O.

DENMARK.—M. A. H. M. Rasmussen, M. Emil Krogh, M. Host, M. Topsöe Jensen; secretary, M. Axel Helper.

H. J. Nierstrass (Holland), Director of the Radio-telegraph Service.

FRANCE.—M. Guernier, M. Tréfeu, M. le Contre Amiral Journet, M. Boris, M. Frouin ; consulting experts, M. Grolous, M. Berthe de Berthe, M. Géraud, M. le Capitaine Brenot ; secretary, M. Keller.

GERMANY.—His Excellency Dr. Von Koerner, Dr. Seeliger Herr Schutt, Dr. Reiss, Professor Pagel, Herr Schrader, Rear-Admiral Behm ; Assistant Delegates—Captain Schmaltz, Herr Walter, Herr Polis, Herr E. Gribel ; Secretary, Herr Voelkner ; attached to the Delegation, Herr von Bulow.

GREAT BRITAIN.—Lord Mersey, Mr. E. G. Moggridge, Sir Archibald Denny, Sir Norman Hill, Sir John Biles, Captain Acton Blake, Captain A. H. F. Young, Mr. C. Hipwood, Mr. W. D. Archer; consulting experts, Captain Loring, R.N., Commander J. T. W. Charles, C.B., R.N.R., Commander M. W. Campbell Hepworth, C.B., R.N.R., Mr. J. Havelock Wilson ; secretaries, Mr. J. A. Webster, Mr. G. H. Locock ; assistant

Count Rev Di Villarey (Italy).

A. Frouin (France), Director of Telegraphs.

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secretaries, Mr. F. P. Robinson, Mr. T. Lodge, Mr. W. Carter, Mr. H. Leak; attached to the secretaries, Mr. G. H. E. Parr.

HOLLAND.—M. J. V. Wierdsma, M. H. S. G. Maas, M. A. D. Muller, M. J. Wilmink; M. J. W. C. Coops (secretary); consulting experts, Professor Vossnack, M. H. J. Nierstrass, M. P. H. Gallé.

ITALY.—Grande Ufficiale Commendatore Carlo Bruno, Commendatore Vittorio Ripa di Meana, Cavaliere Ufficiale Gustavo Tosti, Commendatore Giovanni Battista Veroggio, Cavaliere Filippo Bonfiglietti, Count Carlo Rey di Villarey, Nobile Guglielmo di Palma Castiglione, Commendatore Michele Fileti, Signor Domenico Barricelli; secretary, Cavaliere Pier Luigi Fiore.

NEW ZEALAND.—The Hon. Thomas Mackenzie.

NORWAY.—M. H. Pedersen, Dr. Johannes Bruhn, M. Jens Evang.

RUSSIA.—M. Roman Mikhailovitch Loviaguin.

SPAIN.—Captain Rafael Bausá; secretary, Captain Don Eliseo Sanchiz.

SWEDEN.—Vice-Admiral Olsen, G.C.V.O., M. W. R. B. Lundgren, M. E. Loefgren, M. N. G. Nilsson.

U.S.A.—The Hon. J. W. Alexander, the Hon. T. E. Burton, the Hon. E. T. Chamberlain, Commander E. P. Bertolf, Rear-Admiral Washington L. Capps, Captain George F. Cooper, Mr. Homer L. Ferguson, Mr. A. G. Smith, Mr. Andrew Furuseth, Captain W. H. G. Bullard, and Mr. George Uhler; consulting expert, Mr. McBride; secretary, Mr. Walter R. Alexander.

An Electrostatic Oscillograph

AT the meeting of the Physical Society held recently, a paper on "An Electrostatic Oscillograph," by Messrs. H. Ho and S. Koto, was read by the latter.

The paper describes an electrostatic oscillograph suitable for recording very high voltages. Two vertical bronze strips pass symmetrically between two parallel metallic plates called "field plates." They are connected at their lower ends by a silk fibre which passes under an ivory pulley. An extremely small mirror is fixed in the strips. This arrangement constitutes the vibrator which, mounted on an ebonite frame, is immersed in an oil bath. To the upper extremities of the strips are connected the terminals of a direct-current voltage of about 300. The alternating voltage to be recorded is connected to the "field plates," in parallel with which there are two oil condensers in series. The electrical mid-point of the direct current battery is connected to a point between the condensers.

The turning moment on the strips is proportional to the product of the momentary values of the alternating current voltage and the direct-current voltage, so that if the latter is constant the deflection of the mirror accurately follows the variation of the former.

Oil plays an important part, not only acting as a damper agent and insulator, but increasing the sensitiveness on account of its high dielectric constant.

In cases where the voltage is low, but the source of energy is so limited that a sufficient current cannot be taken to actuate the ordinary oscillograph, the electrostatic vibrator may be used by applying the voltage in question to the strips, while the terminals of a high-tension battery, or influence machine, are connected to the "field plates." The instrument may also be used for recording very small currents by replacing the oil condensers by two exactly equal resistances, which are traversed by the current.

In the discussion which followed the reading of the paper, Mr. A. Campbell thought it was a considerable advantage to be able to do without high resistances. Dr. G. W. C. Kaye had suggested to him that the instrument might be of great use in work with X-rays and in other cases where the charge was being taken from an induction coil.

Mr. R. S. Whipple emphasised the commercial advantage of the instrument. High resistances were very expensive. Einthoven was the first to propose an electrostatic oscillograph, and a Belgian inventor had constructed an instrument similar in principle.

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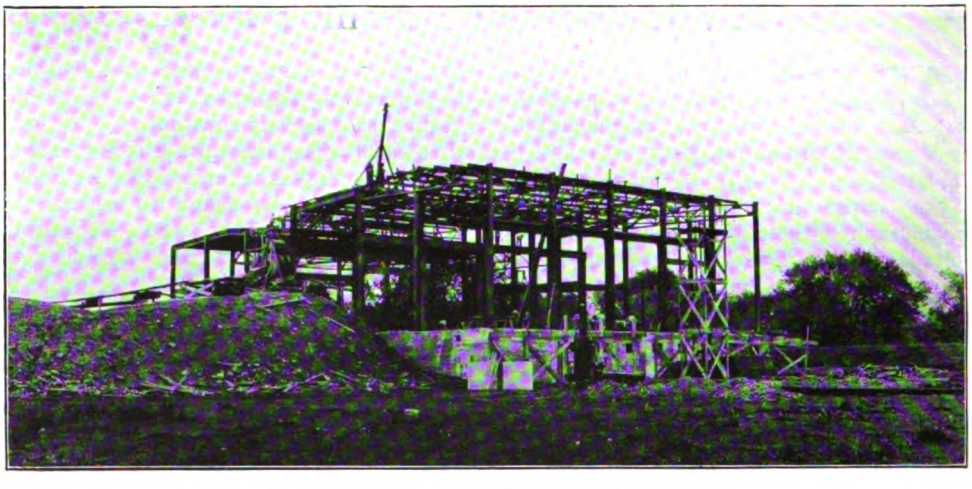
Trans-Pacific Wireless Telegraphy.

Marconi Stations in California Nearing Completion.

THE Marconi high-power stations in California are rapidly nearing completion. These stations will be made up of the transmitting plant at Bolinas Point, eighteen miles north-west of San Francisco, and the receiving station, near the town of Marshalls, about eighteen miles further north on Tomales Bay. Despite the difficulties attending the transportation of building material, the progress on the California sites has been satisfactory. Most of the material for erection purposes—steelwork and machinery, as well as all mast sections and the wire rope—is being made in the East. It is sent from New York by boat to the Isthmus of Panama, across the isthmus by rail and thence by water again to San Francisco.



Bolinas Power House in Course of Construction.

The site at Bolinas is not advantageously located for bringing in heavy loads of material. The rough roads leading to it are at least four miles distant from the highway regularly used for traffic. There is no railway available, and it is necessary to send the material by water from San Francisco, unload it at the wharf at Bolinas Bay, and haul it to the site. Across the mouth of the bay is a shallow sand bar which makes it impossible for a boat of any size to get to or from the wharf except at high tide, and the coast is so dangerous to shipping that owners of vessels are reluctant to have their craft navigated in and out of the bay. As a matter of fact, only one small schooner enters the bay, and she makes the trip only when there is enough material to warrant it. The construction work has strained to the utmost the schooner capacity of 100 tons and overloaded the wharf. A larger derrick has been installed to unload the heavier pieces and the area of the wharf has been extended to give greater space for materials. The fear of winter storms and consequent impassable roads has stimulated the men in

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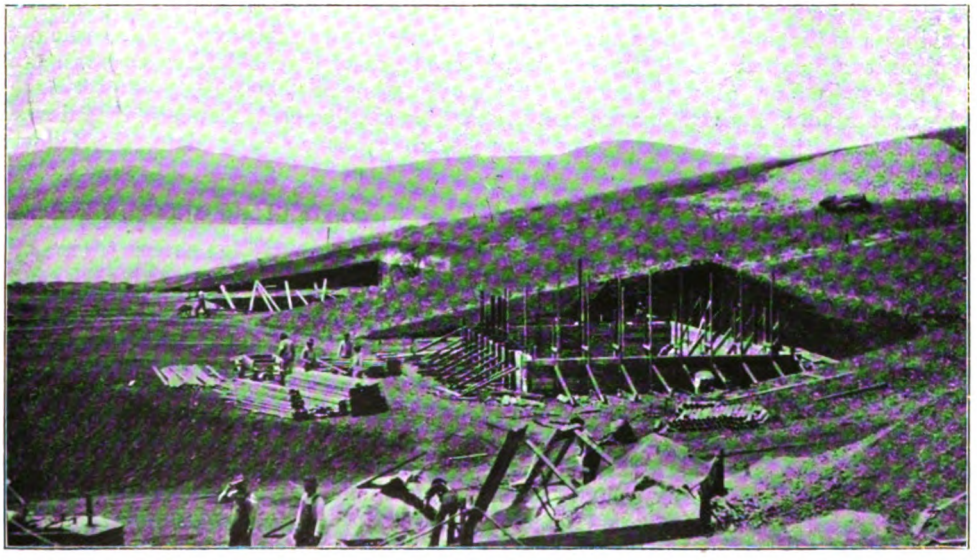
Residences for Chief and Assistant Engineers at Bolinas.

charge of the work to make every effort to transport the machinery and heavy materials as quickly as possible.

The buildings are located on an incline at a height of about 160 feet and within 500 feet from the shore.

The stay anchorages have been put in place and the masts are being erected. The power-house foundations are complete and the piers and foundations for the motor generators, disc dischargers, and other machinery are being erected. Rapid progress is being made in the construction of the headquarters and the residences for the chief and assistant engineers. These buildings are constructed of steel and concrete, with tile roofs to make them fireproof.

To reach the site of the receiving station



At the Site of the Receiving Station, Marshalls.

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it is necessary to ferry from San Francisco to Sausalito, board a train on the North-Western Pacific Railroad, and travel about an hour and a half or two hours on a narrow-gauge railway to the little town of Marshalls on the eastern shore of Tomales Bay. For several months workmen have been busy in this section, with the result that considerable progress has been made in the construction of the buildings which now form a feature of the hillside.

Tomales Bay, celebrated for its clams and oysters, is about twelve miles long and a mile wide. It is navigable for good-sized boats and is extremely popular with fishermen. On the eastern shore, just south of the Marconi property, is located a fishing colony. Along both shores the hills rise abruptly and stretch away on the eastern side in a rolling tableland. The tongue of land between the bay and the ocean is about three miles wide. Covered with heavy woods, this promontory is a favourite summer resort for campers and hunters. It affords good duck shooting and deer are also to be found in the woods. The residential quarters and section for the housing of the lighting and heating plant are about three hundred yards south of the line of the aerial; the operating building at the end of the aerial line is nearly a fifth of a mile from the other structures. These are arranged in a semi-circle above the country road, looking out over the bay from an elevation of one hundred feet. The operating building is on the top of a hill on an elevation of about one hundred and thirty feet.

The construction of the buildings has advanced rapidly. Satisfactory progress has been made on the mast erection. One mast has been completed and stayed, while all the others have at least four sections up. The top plate of the mast foundation can now be accurately levelled up and the last grouting concrete poured.

With regard to the station at Honolulu, work is going along satisfactorily, 141 persons being employed at Kahuku and 108 at Koko Head.

The November meeting of the Institute of Radio Engineers was held at Columbia University, New York, on the 5th ult., when a paper entitled "The Audion—Detector and Amplifier" was read by Dr. L. de Forest.

Directory of Amateur Wireless Stations.

IT is estimated that there are about one thousand licensed amateur experimenters in wireless telegraphy in Great Britain, and this number is steadily increasing. It is only natural, therefore, that there should be a demand for facilities to enable these experimenters to get in touch with their neighbours, which at present they are unable to do in the absence of a suitable directory.

We have decided, therefore, in the interests of the *bonâ fide* amateur, and at the suggestion of some of our readers, to undertake the preparation of a complete directory of amateur wireless stations, which we hope to publish as a special supplement to an early number of THE WIRELESS WORLD.

We believe that the publication of a directory such as we have in view will bring to light a large number of experimenters whose existence is unknown to their neighbours. It will encourage the establishment of wireless associations, and will help to strengthen existing associations by increasing the status of the amateur.

We feel confident that in the compilation of this directory we can rely upon the assistance of the members of the amateur wireless societies and others who are not associated with those organisations, and to whom the existence of a reliable directory will prove of inestimable value.

We shall be glad, therefore, if readers will send us, at an early date, the following particulars for inclusion in the directory:

Name and address.
Call-letters.
Whether the station is for transmitting and receiving, or receiving only.
Transmitting range, in miles.
Transmitting wave-length, in metres.
Receiving range.
Usual hours of working.
General remarks.

Secretaries of wireless associations and clubs will oblige by sending names of their officers, address of headquarters, call-letters and any other useful information.

This directory, when complete, will be distributed free of charge to our readers.

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CARTOON OF THE MONTH

A Bedstead Receiver!

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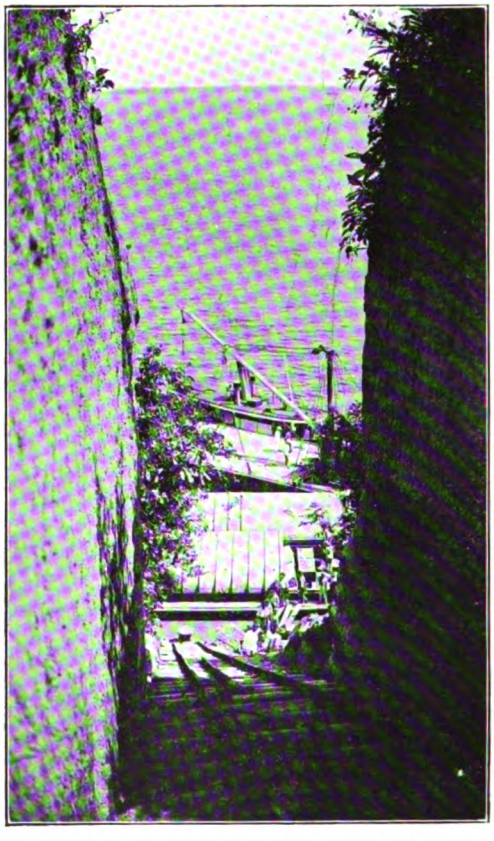
In a South American Forest.

THE BRAZILIAN-BOLIVIAN BOUNDARY COMMISSION. WIRELESS SIGNALS DETERMINE DIFFERENCE OF LONGITUDE. EXPERIENCES OF THE COMMISSION. DANGER TO OVERHEAD TRANSMISSION LINES.

IT is now nearly three years ago that the wireless telegraph stations were erected at Manaos and Porto Velho, and since then Brazil and Bolivia have witnessed great developments, due in a large measure to the civilising agency of wireless telegraphy, for it is only by this means that the far-away districts of Central America can be brought into touch with the world at large. How far they are away may be judged by the fact that the boundary line between Brazil and Bolivia yet remains unsettled, and there are large tracts of country still untraversed and unsurveyed. Nevertheless, this state of things is not likely to continue much longer. For three years Commander Edwards and a party of explorers and surveyors have been settling this difficult question of boundaries, and at the same time exploring the country.

After a period of strenuous work Commander Edwards returned to England for a short time this year, and during his brief stay found time to deliver an important and interesting lecture on his work before the Royal Geographical Society. Now he is once again in Bolivia at the head of the Bolivian Boundary Commission, and is reported to be awaiting the arrival of the Brazilian Commissioner, General Pando, before starting on a campaign of wider exploration.

One feature of the work of the Commission must be mentioned here, inasmuch as it illustrates an important use of wireless telegraphy. It was perhaps little dreamt at the time when the now famous stations at Manaos and Porto Velho were erected by the Marconi Company for the Madeira-Mamoré Railway that, in addition to their ordinary work, they would communicate to an intrepid party of explorers, sent into a South American forest to carry out so delicate an operation as the determining of



Porto Velho. Landing material for the Construction of the Wireless Station.

the boundary between two contiguous countries, signals that would enable the explorers to discover the difference of longitude between two given points, thus rendering them independent of chronometers. This is exactly what has been done, however.

Since its arrival the Commission has been determining the difference of longitude between Manaos and Porto Velho by means

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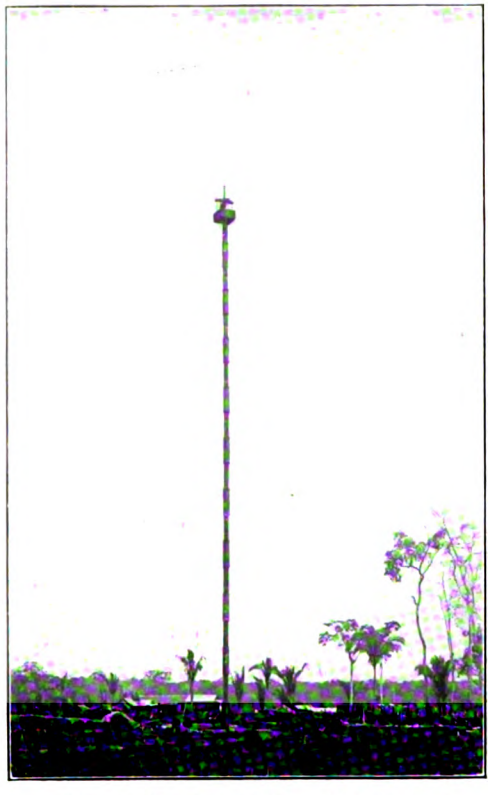
of exchange of wireless signals. The result will make the Commission independent of chronometers during the journey from Manaos to Porto Velho, and this will mean a great saving of time and anxiety, for chronometrical work is tedious and difficult, and observations have to be taken frequently, so that deficiencies, which constantly occur, may be rectified, and a workable approximation obtained.

Commander Edwards' first expedition on frontier work was commenced in 1911, and was the result of a report from Colonel Fawcett, who headed an exploratory party through this region in 1907. The journey was one of 2,000 miles up the River Purus, and its tributary the Acre, which brought the party to the Bolivia-Brazil boundary line in time to commence survey work at the beginning of the dry season. The main streams of these two rivers are fairly well known, and are open to small steam navigation for four or five months during the wet season of the year—December to April—during which time food supplies are rushed up to the depôts situated on the river bank, and a large quantity of india-rubber is brought down.

One of the towns visited by the expedition was Empreza, the capital of the Prefecture of the Acre. It possesses about 1,200 inhabitants, and Commander Edwards was hospitably entertained by the Prefect, who enthusiastically pointed out his schemes of improvement, and was particularly proud of the installation of the wireless station, which had just been erected. The region of Acre is known as "Inferno Verde," or Green Hell, and hints at the lawlessness of the inhabitants. At Capatara the party first experienced the *friajem* or cold snap, known in Bolivia as the *Suracon*. This is a sudden change in the weather, usually heralded by a fierce storm of ice-cold rain and wind, during which the temperature falls rapidly from its normal of about 90° F. in the shade to round about 47° F. These *friajems* last from four to seven days, and are of frequent occurrence during the dry season from May to September, causing great inconvenience, and even hardship, to the sun-loving worker in these parts, who, during the continuance of the low temperature, rarely leaves his hut or hammock. In the forest all is still, not



Manaos Station. View of the mast.

an animal moves from its nest or lair, the birds sit dumbly huddled together amongst the topmost branches of the trees, the silence of the swamps is unbroken by the usual music of the frogs, the leaves of many trees and shrubs close together, and many crumple up and die. All Nature appears in a state of suspended animation, but bursts forth into exuberance again as soon as the sun shines and the sky clears.

From Capatara a thirteen-mile journey through dense forests was made to Rapirran, where the Central Frontier station was established, and this practically completed the work for that year.

In May, 1912, work was commenced at Cobija, and the Commission traversed and mapped the frontier line of the River Acre from Cobija to Tacna. The water in the river was unusually low, and the work of dragging their laden canoes over the sand-banks and snags was arduous in the extreme. The bed of the River Acre above Sacada is

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literally strewed with snags, stumps of trees, etc., and in several places the river breaks into *cachuelas* or rapids, which, however, are easily passed by lightly laden canoes. At Tacna, where the three countries of Bolivia, Brazil and Peru touch, permanent boundary marks were erected, and the Commission returned to Cobija. After erecting the permanent marks at Cobija, the party passed into the forest to the source of the Arroyo Bahia.

The exploration of the Arroyo Bahia and Floresta was soon finished, and the Commission returned to Cobija, and thence to Manaos, voyaging 1,500 miles down river in their own little motor boat, 30 feet in length.

The annual rise of the rivers commences about the middle of October, and they are at their highest in January. The Acre rises thirty feet, the Iquiry, Rapirran, Ina and Xipamanu about twenty feet.

Usually the last big *ripoquette* takes place towards the end of May, and is given the name of *mata-feijoe*, or the *beankiller*, as it sweeps away the young bean plants which at that time are well above ground. In March and April, as the waters fall, the natives clear away all vegetation from the sandy banks and playas of the rivers, and plant beans thereon, and great hardship and loss result to them should the *mata-feijeo* be of unusual strength. This bean sowing is practically the only general agricultural process in operation, though in the vicinity of the townships of Empreza, Xapury and Cobija, and at some of the large depôts on the Acre, settlers are cultivating sugar-cane, coffee, mandioca (from which they make flour and a spirituous liquor something like gin), macaxera, maize, yams, pineapples, oranges, mangabas, and papaia or mamao. Yet the soil is wonderfully fertile, and with very little toil returns a harvest out of all proportion. The Government of Bolivia is pursuing the wise policy of making small grants of land near Cobija to time-expired soldiers, and thus is building up a type of colonist, attached to the land, with local interests and aims. Brazil will, no doubt, follow suit, and the day may not be far distant when these remote regions will supply their own population with the immediate necessities of life, instead of being, as at present, dependent on supplies brought up at enormous freight charges by river steamers from Manaos and Para.

Porto Velho. General view of one of the Wireless Telegraph Stations which communicated with the Boundary Commission.

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The banks of the River Acre are dotted with rubber deposits, usually consisting of a store, rubber shed, and a few barracas or huts, erected in a clearing, and from these depôts long straight *varadors* or mule roads are cut through the forest, as far back as the limits of the seringal extend. Away from the Acre depôts, but on the *varadors*, are the *centros*, or distributing and collecting centres, which are always in touch, by means of mule transport, with the depôts; and away from the *centros* in the depths of the forest are the isolated "barracas" of the actual rubber collector.

It is sacrilege to lay violent hands on the rubber tree, and in the seringals, or rubber estates, questions of poaching are settled out of hand with the rifle, usually without time being allowed for personal explanations.

This illustrates the danger to overhead transmission lines by falling trees in the Amazon district.

The Government of Ecuador have drawn up a Bill to be laid before the present Congress for the installation of wireless telegraphy, at an expenditure of £30,000.

"Wireless is the great life-saver at sea, and it also has smaller uses. A friend of mine just returned from South Africa says that his ship's doctor played chess most of the way with the doctor in the *Kenilworth Castle*, the latter being many miles in the rear."—Mr. Gossip in the *Daily Sketch*.

PHILLIPS MEMORIAL.

After many months of delay a site has at last been found at Godalming for the memorial to Jack Phillips, the chief wireless telegraphist of the *Titanic*, who was a native of the town. When a site had been almost secured nearly a year ago difficulties arose, with the result that the Memorial Committee, which includes the Mayor, Alderman E. Bridger (chairman), Mrs. G. F. Watts, Lady Chance, the Hon. Mrs. Arthur Davey, and Mrs. W. E. Horne, had to look elsewhere. The site now chosen is glebe land near Godalming Parish Church, and the assent of the Ecclesiastical Commissioners, the Bishop of Winchester, and the vicar, the Rev. G. C. Fanshawe, has been obtained. The land, three acres in extent, is to be bought by the corporation for £300, and the Memorial Committee will contribute £50 towards the cost in return for the piece of land they will require. The remainder will be utilised by the Corporation as a recreation ground, and a shed will be erected to provide facilities for bathing in the River Wey, which flows past the land. The design of the memorial, which is by Miss Gertrude Jekyll and Mr. Thackeray Turner, is for a rectangular cloister of some 120 feet square. The memorial will cost between £600 and £700.

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NOTES OF THE MONTH

STATE RESEARCH IN RADIOTELEGRAPHY. THE POST OFFICE YEAR. "LLOYD'S." WIRELESS TELEGRAPHY AND NATIONAL AMITY. THE ART OF SPECIALISING.

THE Postmaster-General has appointed a committee to consider how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with ordinary telegraphy and telephony. The committee's office is at 6, Catherine Street, Strand, London, W.C. The names of the members of the committee are as follows: The Right Hon. C. E. H. Hobhouse, M.P. (chairman), the Right Hon. Lord Parker of Waddington, Sir Joseph Larmor, M.P., F.R.S., Sir Henry Norman, M.P., Dr. R. T. Glazebrook, F.R.S., Mr. W. Duddell, M.I.E.E., F.R.S., Mr. R. Wilkins, C.B., Rear-Admiral E. F. B. Charlton, R.N., Sir Alexander King, K.C.B., Mr. W. Slingo, Commander F. Loring, R.N., Major the Hon. H. C. Guest, M.P., and Commander J. K. Im Thurn, R.N. Of the members of the new committee Lord Parker of Waddington, Mr. W. Duddell, F.R.S., and Dr. R. T. Glazebrook, F.R.S., were also members of the technical committee appointed last January on the recommendation of the Select Committee on the Marconi Contract, Lord Parker being the chairman. The reference to that committee was "to report on the merits of the existing systems of long-distance wireless telegraphy, and in particular as to their capacity for continuous communication over the distances required by the Imperial chain," and they reported in due course.

* * *

The annual report of the Postmaster-General is one of the most interesting documents issued by any Government Department. It reflects the work of a department which touches the public more closely than is generally imagined, and if the Post Office receives an ample share of criticism, it is because it is so great a public convenience. The report for the year ended March 31st, 1913, shows how enormous is the volume of business transacted by the department which is controlled by the Postmaster-General. More than five and a half million postal packets and six million parcels passed through it last year, and it is estimated that the value of goods exported and imported by parcel post during the same period amounted to more than ten and a half million pounds sterling. The pages of the report throw a flood of useful light upon the banking, telegraphic and other business conducted through the Post Office, revealing an organisation of which the country has just cause to be proud. We turn with interest to that section of the report dealing with wireless telegraphy, and in the few printed sentences we find evidence of the maintenance of the steady increase in business. The number of radio-telegrams dealt with at the Post Office Coast Stations during the year was 51,109 (43,650 inwards and 7,459 outwards), as compared with 44,507 last year—an increase of about 15 per cent. These figures show that the public are beginning to realise and take advantage of the opportunities that exist for communicating with ships at sea, and if the existence of these facilities for sending radio-telegrams were better known, the returns would show a considerable increase. As it is, progress is assured by the rapidly increasing number of ships having wireless installations. Readers of the Postmaster-General's report will not fail to note the growth in the number of wireless telegraph licences granted during the year. In all, 729 new licences, covering 869 stations, were granted in the United Kingdom under the Wireless Telegraphy Act for the purpose of experiments, while 45 licences for experimental stations were cancelled or expired. On March 31st last there were in existence 942 licences for the purpose of experiments, as compared with 258 on March 31st, 1912. The number of licences in operation for wireless telegraphy on board ships registered in the United Kingdom was 105, covering 646 ships, as compared with 72 licences covering 450 ships on March 31st, 1912.

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"Lloyd's" annual report supplements some of the information published in the report referred to above. It covers practically the same period as the Postmaster-General's report, which it resembles in this respect: that whilst it evidences the considerable growth in the application of wireless telegraphy, it shows likewise what an enormous field there is for commercial development. At the close of the Society's year ended June 30th, 1913, 10,466 merchant vessels, registering over twenty-two and a half million tons gross, held classes assigned by the Committee of Lloyd's Register. Of these 1,932 vessels were recorded in the Society's Register as fitted with wireless telegraphic installations as compared with 1,392 at a corresponding date last year, and 806 fitted with submarine signalling apparatus, as compared with 630 last year. The increase in the number of vessels equipped with wireless telegraphic apparatus during the past year is a feature which stands out prominently in the report, and although the number of vessels now equipped with wireless is small in proportion to the number of vessels registered, we are convinced that at the present rate of installing the figures will be more in line within a very few years. The report tends to show that the vast majority of new ships have been equipped, and that it is among the older vessels that wireless is not making such rapid progress as might be desired. Last year 651 new vessels were built, 593 being steamers and 58 sailing vessels. During the same period 540 vessels were fitted with wireless telegraphic installations, so that on the whole there is little cause for complaint in respect of modern vessels.

* * *

It is gratifying to note that wireless telegraphy played a not unimportant part in the inauguration of what there is every reason to believe will be an era of close friendship between France and Spain. On the conclusion of a visit by the French President to Spain which will be a memorable event in the annals of the two countries, courtesies by wireless were exchanged between M. Poincaré and his royal host. M. Poincaré sent a wireless dispatch from the *Diderot* to King Alfonso, who was on board the battleship *Espana*, expressing his gratitude to King Alfonso, Queen Victoria, and the Spanish nation, for the sincere and friendly welcome he had received and the cordial sentiments shown for France, and conveying the warmest wishes of France for the King and Queen and for Spain. King Alfonso replied in a wireless telegram thanking the President sincerely in the name of Spain, the Queen and himself, and expressing the warmest wishes for the greatness and prosperity of France and the happiness of M. and Madame Poincaré.

* * *

In the course of his inaugural address to the Manchester section of the Institution of Electrical Engineers, Professor E. W. Marchant discussed the place of the electrical engineer in the industrial world and the reward he should receive. He maintained that electrical engineering had developed in so many directions that it was impossible for one man to keep in touch with all the branches of activity in which electrical engineers are employed. It is quite true, as stated by Professor Marchant, that the electrical engineer of to-day is a "highly specialised person," and it is interesting to consider how far the specialist from the training college can fulfil the requirements of wireless telegraphy. The development of this branch of industry has resulted in the demand for a definite type of engineer possessing qualifications that are common to other branches of engineering. The nature of the work on which the wireless telegraph engineer is engaged is such that knowledge of mechanical and civil engineering is no less a requirement than that of electrical engineering. In practical work he is concerned with the installation of various types of plant, in addition to the wireless gear. He has to erect large masts with the corresponding systems of aerial wires and earth wires, and he must be so versatile that he should be able to organise a telegraph business which has to work as regularly as if it were on an ordinary land line. It is thus evident that the average student of a technical college who has specialised in any one particular branch of engineering will find himself at some disadvantage if he enters the profession of wireless telegraphy, and it is perhaps just as well to make it quite clear that the type of man required is not so much an electrical as a general engineer.

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Administrative Notes

A New Post Office Station.

A LETTER has been received by the Devizes Town Council from the Commissioners of Woods and Forests stating that the Postmaster-General is about to erect a small power station on the Marlborough Downs at a point about five miles from Devizes, where the corporation waterworks are situated. It has been known for some time that a wireless station was contemplated at this point, but this is the first official information. It is conveyed in the course of a letter asking for a supply of water to the station.

* * *

Wireless Licences to Military Officers in India.

ACCORDING to the *Englishman* of Calcutta, the Government of India have decided that the granting of licences to military officers in respect of wireless telegraph apparatus used for experimental purposes shall be regulated by the following general principles: (1) When an officer conducts experiments in wireless telegraphy in his official capacity at the expense of Government no licence is required, but only executive permission, which may be given so far as the Telegraph Department is concerned by the Director-General, Posts and Telegraphs.

(2) When an officer carries on experiments as a private individual at his own expense he must obtain a licence. If the approval of the military authorities is required to what he proposes to do he should obtain such approval before the Director-General, Posts and Telegraphs, is approached. The licence will then be submitted by the Director-General, Posts and Telegraphs, for the sanction of the Government of India.

(3) With reference to the above, attention is drawn to the necessity for applying for licences to own and use wireless telegraphy apparatus or installations, experimental or otherwise. Applications for such licences will be submitted through the Chief of the General Staff and will contain particulars regarding the apparatus showing (*a*) system it is proposed to employ, (*b*) maximum range of signalling with applicants' own receiving apparatus, (*c*) power (current and voltage), (*d*) source of power.

* * *

Time Signals.

THE Japanese Government has notified that the shore station of Choshi transmits time signals every night, except Sundays. The following list of shore stations are officially announced to send out time signals:

Station.	Time of Transmission.	Wave-length.
		metres.
GERMANY:		
Norddeich	Mid-day and Midnight by Greenwich time.	1,650
Tsingtan (Signalberg, China)	Mid-day and 8 p.m. by time of meridian 120° East of Greenwich.	1,250
UNITED STATES OF AMERICA:		
Arlington, Va. ..	Mid-day and 10 p.m. by time 75° West of Greenwich.	2,500
Boston, NAD ..		
Charleston, S. Carolina		
Key West, Flo. ..	Mid-day by time 75° West of Greenwich.	1,000
New Orleans ..		
Newport, Rhode Is.		
New York, NAH ..		
Norfolk, Va.		
Eureka, Cal. ..		
Mare Island ..	Mid-day by time 120° West of Greenwich.	1,000
North Head ..		
San Diego, Cal. ..		
Tatoosh		
JAPAN:		
Choshi	9 to 9.4 p.m. by time 135° East of Greenwich.	600
MEXICO:		
Campeche		
Guaymas	Mid-day by meridian of Tacubaya.	—
Mazatlan de Sinaloa		
Payo Obispo		
Veracruz de Veracruz		

* * *

Dutch Vessel Fitted.

THE Administration of the Netherlands has informed the Berne Bureau that the steamship *Van Lansberge*, belonging to the shipping company "Koninklijke-Paketvaart Maatschappij" of Amster-

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dam, has left Amsterdam on September 10th for Batavia, and that it is fitted with a wireless station. The provisional call-letters for this station are "P M G" and the tax for messages sent by this station is 40 centimes a word, with a minimum of 4 francs per telegram.

* * *

Australian Coast Stations.

THE following additional stations in Australia have been opened for the transmission of public correspondence: Geraldton (W.A.); Rates, 6d. per word (no minimum); call signal, VIN; hours of attendance, 8 a.m. to midnight. Rockhampton (Q.): Rates, 6d. per word (no minimum); call signal, VIR; hours of attendance, 8 a.m. to midnight. Cooktown (Q.): Rates, 6d. per word (no minimum); call signal, VIC; hours of attendance, 8 a.m. to midnight.

* * *

Spanish Stations.

IN accordance with a Royal Order of July 12th last, and in reply to the Royal Order of the Minister of the Interior of December 7th, 1912, the Minister of War has made known that there is no objection on his part to the establishment of a radio-telegraphic station on Cape Finisterre, provided it be subject to the dispositions of the laws in force relating to coastal and frontier military zones.

The installation of a station on Cape Mayor, in the province of Santander, was approved, subject, in case of need, to the possible requirements of building a battery projected by the War Department for the defence of that part of the coast. The said station, with a permanent service, was opened to the public at current rates in July last. The Minister of War has also given his consent to the station in Malaga at the site known as Almellones.

* * *

Weather Reports.

THE Department of Posts and Telegraphs, Pretoria, announces that the radiotelegraph stations at Cape Town and Durban will signal at 1 o'clock in the afternoon of each day weather reports containing information relative to the meteorological conditions affecting the coastal belt of the South African Union.

* * *

Indian Telegraphs.

THE annual report of the Indian Telegraph Department for 1912–13 states that new wireless telegraph stations were opened during the year at Karachi and Butcher Island, Bombay, with a working range of 600 miles, for the exchange of ships at sea, and the temporary station at Bombay was closed. In addition to the erection by the department of the four large Marconi stations at Karachi, Nagpur, Lahore and Bombay, an important event of interest in India has been the large increase which has taken place in the number of ships fitted for wireless telegraphy. Most of the passenger steamers plying regularly in Indian waters are now fitted with wireless apparatus. The increased demands made by ships on the coast stations have been met by opening a new station at Karachi, and by arranging that Calcutta, Diamond Island, Mergui and Victoria Point should operate by night as well as by day.

The opening of the stations named in the list given below is advised in the last supplement to the official list of wireless telegraph stations:—

Name.	Call Signal.	Normal Range in Nautical Miles.	Wave-length in metres (the normal wave-length is printed in italics).	Remarks.
Nassau, Bahamas (British West Indies)	VPN	400	*600*, 1,800	Open for general public business.
Archangel (Russia) ...	RQA	250	300, 420, *600*	Open for public business. The coast charge is 0·60 fr. per word, but for communication with Russian coast and ship stations it is 0·13 fr.
Sierra Leone... ...	VPU	250	300, *600*	Open for general public correspondence.
Guadalajara (Spain)	ECZ	54	900	Owned by the Ministry of War.

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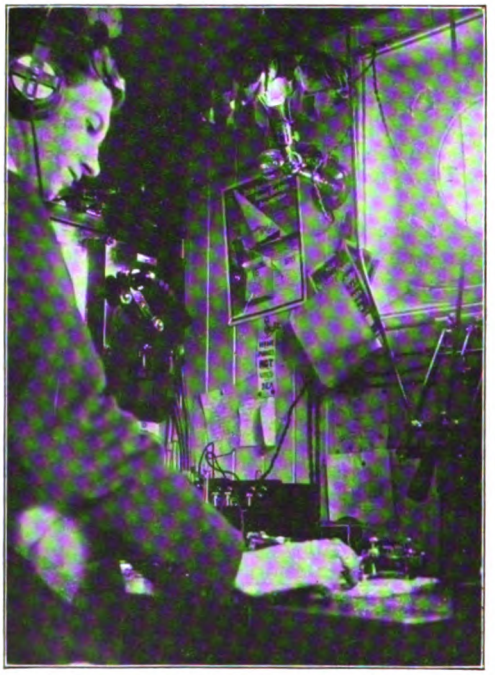
Maritime Wireless Telegraphy

IN a recent issue we described some highly successful experiments with wireless telegraph apparatus on board steam trawlers, which resulted in the Marconi Company receiving instructions to equip several of these vessels. One of the first vessels thus equipped is the *Cabban*, on which is installed a ½ k.w. set. The trawler's masts are each 65 feet in height, with 70 feet



Mr. J. Lees, operator on the "Czar," one of the vessels which answered the wireless call for help from the Volturno and saved 102 passengers.

between them. The range over which these small stations communicate is governed by the height of the masts, and in the case of the *Cabban*, the guaranteed range was 100 miles. The vessel left Hull on November 7th, and so successful was the working of her "wireless" that communication was maintained over a distance of 150 miles.

* * *

A mysterious incident has just been reported on the arrival of five men at Plymouth, who were picked up by the P. & O. Liner *China*, and who stated that they are the crew of a new steam tug, the *Nana*, which had set out towards its destination, which is Rio Galangoes, in Patagonia. Soon after the *Nana* had started from Brightlingsea, and was making its way down the Channel, bad weather was encountered so that the little vessel shipped heavy seas, and by daylight had developed a list to port. In order to right the vessel it was decided to cut away part of the bulwark and lower the lifeboat and tow it astern. All the men were ordered into the lifeboat, and the only man left on the steam tug was the captain. Then, as the vessel righted itself, the strain broke the rope and the lifeboat drifted away, so that the *Nana*, with Captain Kite alone on board was soon out of sight in the surrounding darkness. Fortunately for the men on the lifeboat they were picked up by the *China*, and when the commander of the rescuing vessel heard the men's story he sent out a wireless message asking that a tug should be dispatched from Falmouth to search for the little steam tug and its single passenger. The work of rescue was, however, accomplished by the German steamer, *E. Russ*, who brought back Captain Kite and his vessel to Falmouth, but it is satisfactory to note that the work of rescue did not rest solely upon a chance meeting with a passing vessel, but that efforts could be, and were, made to reach her, a thing only possible through the sustained efforts of wireless telegraphy.

* * *

The *Mount Temple* of the C.P.R. Line from London to Montreal stuck fast in the mud in the St. Lawrence River opposite her point of destination on October 24th. The vessel was refloated two days later only after she had been lightened of a considerable portion of her cargo. On the vessel going aground the Commander at once dispatched wireless calls for assistance to the C.P.R. Marine Superintendent, and within a very short time numerous tugs were on the scene.

The wireless installation on board the *Mount Temple* rendered valuable service, as

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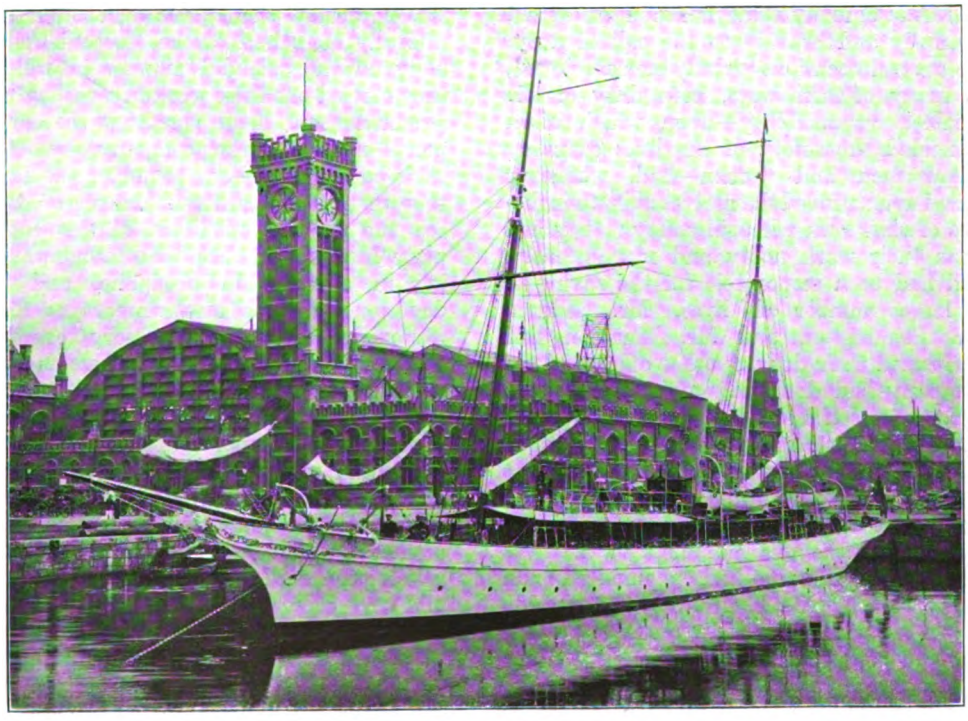
by the intermediary of the Montreal station, continuous twenty-four hour communication was maintained with the ship, and the C.P.R. office was kept advised of the progress made in the efforts to release the vessel.

* * *

The equipment of the yacht *Leda*, which is owned by Mr. G. L. Carels, the well-known engineer and manufacturer, of Ghent, who is Honorary President of the Royal Yacht Club, is notable for many reasons, not the least important of which is that the *Leda* is the first Belgian yacht to have a wireless installation. The set is installed in a cabin on the bridge measuring only 3 ft. 8 in. Notwithstanding the small space occupied, the *Leda* station is quite complete, with singing spark, and capable of receiving waves of different lengths. A standard ½ kw. set is employed, the power being obtained from the ship's accumulator battery, which, in turn, is charged by the ship's dynamo. The receiving apparatus comprise the Marconi multiple tuner and magnetic detector. The dimensions of the aerial are, of course, limited, the distance between the masts being about 20 metres, and the height about 22 metres above the waterline. The range of the station is 200 kilometres. The aerial has attracted considerable attention, because the Belgian public are not accustomed to the sight of the familiar wires suspended between the masts of this class of vessel. The installation of the *Leda* is a reminder that yacht owners are becoming more alive to the advantages of Mr. Marconi's invention, and in the United States and Great Britain a great many yachts have now their stations. This is not to be wondered at when we remember that yachting is a recreation indulged in by many whose occupations and interests do not permit them to remain for any length of time unacquainted with the world's happenings. Thanks to wireless telegraphy, busy men can now leave the toils and cares of life in the city, and follow their favourite pastime without losing touch with what is going on in their absence.



The Yacht "Leda" showing Aerials.

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Wireless Heroes

AN impressive ceremony took place in the school at Marconi House, London, on November 12th, when the *Volturno* operators, Mr. Walter Seddon and Mr. C. J. Pennington, and the *Templemore* operator, Mr. R. Emanuel, were presented by Mr. Marconi, on behalf of his company, with gold watches in commemoration of the splendid work they performed under circumstances that are still too fresh in the public memory to need mentioning here.

The presentations were made in the presence of a large gathering of the students attending the Marconi day classes, to whom the proceedings were of especial significance, as many of them were on the eve of entry into the profession which was honoured by the records of heroism and devotion to duty about to be commemorated that day.

The opening remarks of Mr. Godfrey C. Isaacs formed a keynote of the proceedings. He observed that nobody employed in the Marconi Company had ever failed to respond manfully and bravely to the call of duty. On several occasions already men employed, as many of them were, in a duty of the greatest responsibility—upon which often depended the safety of the lives of many fellow men and women—had, whenever called upon, proved themselves quite thoughtless of their own personal safety; they had done their work nobly and magnificently, and had been responsible for the saving of a large number of lives. Mr. Seddon, Mr. Pennington, and Mr. Emanuel had performed their duty as other officers of the company had done on previous occasions. That of itself should constitute a great satisfaction to every man upon whom such an opportunity devolved, for it was that sense—that inward feeling—of having done one's duty which constituted the real satisfaction and the real happiness in the lives of men. A man who had encountered such an opportunity and had risen to the occasion would go through life ennobled by the thought of his achievement.

Mr. Isaacs added:

"It has been and it will continue to be our custom to present each of those gentlemen who do their duty in the way that these men have done with a little souvenir of the occasion. Nothing that we can do can possibly show the real appreciation that one has for the work which has been performed in this direction, but one does feel that one wants to have the opportunity of presenting something from the company to be kept throughout all time as an indication of the way in which the recipient has carried out the duties in his lifetime. Therefore we took this opportunity of asking these gentlemen to be present to-day in order that Mr. Marconi may present each of them with a little souvenir for himself and for the company."

Mr. Marconi then said:

"There is not much which I can add to what has been said so ably and so eloquently by our Managing Director, Mr. Godfrey Isaacs. I wish, however, to congratulate these three operators most sincerely on behalf of the Marconi Company on the splendid manner in which they carried out their work in most trying circumstances. I am sure that the company—not only the company, but all their countrymen—are proud of the fact that in time of peril and danger on the sea the wireless operators of this company have never once been found wanting in courage, in discipline, and in devotion to their most important and responsible duties. The story of the *Volturno* and of the *Templemore* is too well known for me to refer to, but it is a story that will live. I think the memory of these wireless operators who have done their duty will also live, and will be one of the things to which seamen and sailors and all those connected with this new science of wireless will look back upon with satisfaction and with pride. I cannot add any more, but I am glad to have had this opportunity of showing this mark of appreciation to these three employees, to these three fellow-workers of ours, as Mr. Isaacs has put it, who have done their duty so well and so bravely."

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Contract News

Vessels fitted with Marconi Apparatus since the last issue of the *Wireless World*.

Name.	Owners.	Installation.	Call Letters.
Columbia	Hellyers Steam Fishing Co.	3 kw. and emergency	MFH
Cardiganshire	R.M.S.P. Co.	1½ kw. and emergency	MAU
Alaunia	Cunard Steam Ship Co.	,,	GAI
Glenetive	Caledonia Steamship Co.	,,	MEZ
Baron Jedburgh	H. Hogarth & Sons	,,	MGD
Highland Brigade	Nelson Line	,,	MCZ
Highland Harris	,,	,,	MDO
Banca	P. & O. Line	,,	MFS
Star of India	J. P. Corry & Co.	,,	GYZ
Star of Australia	,,	,,	MAH
Engineer	T. & J. Harrison	,,	MFO
Statesman	,,	,,	MHP
Kumara	Shaw Savill & Albion Line	,,	MFG
Mexico	Compania Mexicana de Navigacion	,,	XBB (provisional)
Amber, C. S.	Eastern Telegraph Co.	,,	GFI
Hatumet	H. B. & A. Gourlay	½ kw. and emergency	MGR
Swazi	Bucknall Steamship Line	,,	MAV
Karema	,, ,,	,,	MAF
Caliban	Hellyers Steam Fishing Co.	,,	MGS
Bardolph	,, ,,	,,	MGE

Orders have been received to equip the following Vessels with Marconi installations.

Name of Vessel.	Owners.	Type of Installation.	Call Letters.	Remarks.
Montcalm	Belonging to the Canadian Government	½ kw. and emergency	—	To refit with modern apparatus.
Lady Grey	,, ,, ,,	,,	—	
Druid	,, ,, ,,	,,	—	
Simcoe	,, ,, ,,	,,	—	
Lurcher	,, ,, ,,	,,	—	Lightship.
Trinidadian	The Trinidadian Co., Ltd.	,,	GLH	Trading between West Indies and N.Y.
Rossetti	Messrs. Lamport & Holt, Ltd.	1½ kw. and emergency	MEY	Trading between South America and the River Plate.
Raeburn	,, ,, ,,	,,	MES	
Raphael	,, ,, ,,	,,	MET	
Rembrandt	,, ,, ,,	,,	MEU	
Romney	,, ,, ,,	,,	MEV	
Desabla	Andrew Weir & Co.	,,	GYV	The *Desabla* and the *Barneson* are engaged in general foreign trade, while the other vessels are chiefly engaged in transit work between India and Africa.
Barneson	,, ,, ,, ,,	,,	GYW	
Surat	,, ,, ,, ,,	,,	GEL	
Kathiawar	,, ,, ,, ,,	,,	GEM	
Gujarat	,, ,, ,, ,,	,,	GBO	
Massilia	The Anchor Line	,,	MHH	Three more of this famous line of passenger vessels engaged in the Bombay service to be fitted with Marconi installations.
Olympia	,, ,, ,, ,,	,,	MHI	
Scindia	,, ,, ,, ,,	,,	MHJ	
Kelvinia	The Glasgow Steamship Co., Ltd.	,,	MGQ	General cargo.
El Cordobes	The British and Argentine Steam Navigation Co., Ltd.	,,	MHO	Engaged in South American trade.

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Our Bookshelf

WIRELESS TELEGRAPHY AND TELEPHONY. By Charles R. Gibson, F.R.S.E. London: Seeley, Service & Co. 5s. net.

On the whole "wireless" has been very fortunate in the men it has found to write about it. It is true that at times a good deal of unsound stuff has appeared dealing with the subject, but lately, at any rate, we have had occasion to notice a number of small books on the subject at which some of the older sciences must look with envious eyes; rather as the present generation, looking back to its childhood, grumbles that it never had the advantages and luxuries, the toys and the good time generally, which it sees offered to the generation growing up around it.

The latest example which we have come across is the thoroughly well-produced book whose title is given above. Here, helped by a large number of excellent illustrations, is a very plain and straightforward "popular account of the past and present of wireless telegraphy and telephony," which assumes, as the author states, "no previous knowledge of the subject on the part of the reader." It does not profess to go very deeply into the subject, but it gives just those clear introductory outlines which, we feel sure, will leave many a reader with the determination to explore further; while those readers who have no time for such fascinating explorations will be content to know that, after reading this book through intelligently, they really have a sound and reasonable idea of what wireless telegraphy and wireless telephony are.

We have only one quarrel with Mr. Gibson. He quotes the late Professor Ayrton's early prophecy: "The day will come, when we are all forgotten, when copper wires, gutta-percha covers, and iron bands are only to be found in museums, that a person who wishes to speak to a friend, but does not know where he is, will call with an electrical voice which will be heard only by him who has a similarly tuned electric ear. He will cry 'Where are you?' and the answer will sound in his ear, 'I am in the depth of a mine, on the summit of the Andes, or on the broad ocean.' Or perhaps no voice will reply, and he will know that his friend is dead. . . ." Our quarrel with Mr. Gibson is that he refers to this as a "humorous prophecy." To anyone who is thoroughly imbued with the spirit of the "wireless" this adjective jars, rather as it would if applied to a part of Ecclesiastes.

* * *

"LIGHTSHIPS AND LIGHTHOUSES," by Frederick A. Talbot. (London: William Heinemann, 6s. net.)

The author's gift of language and his skill in investing what would, in other hands, be heavy material, with the charm of romance and vivid narrative, is as abundantly evident in Mr. Frederick A. Talbot's new book on "Lightships and Lighthouses" as it was in his previous volumes. There is not a dull page in the book, for we find the story of the safeguarding of the world's coast line brimful of incident and adventure.

Humour plays an occasional part in the tale of sea life, and some of Mr. Talbot's descriptions of storm and danger are vivid writing, and when it is remembered that such storms as he describes are no uncommon experience to the dwellers on these outposts of civilisation, it adds a fearful realism to the tales he has to tell. Another point he brings out clearly is the desolation which the lighthouse keeper is forced to endure. Often we come across such passages as this in his book: "Belle Isle is a lonely station in the fullest sense of the word, for six months the guardians of the light are isolated from the world at large. . . . As the wireless installation is closed down when navigation ceases, the keepers and their families settle down to the weary vigil, knowing nothing of the rest of the world, and all but forgotten by civilisation, for the storms and stress of winter often rupture the submarine cable, which cannot be repaired until the ice disappears." What communication with the outside world means to these watchers, a reference, made by the writer, to the wireless installation on Sable Island, off Nova Scotia, will explain: "The life of these lonely workers now is

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lightened very appreciably, as the island is fitted with a wireless station, wherewith the men are able to talk through space with the mainland, and with passing vessels."

Mr. Talbot commences his chapter on the Guardian Lights of Canada's Coast with a description of the beacon at Cape Race, where, as is well known, an important wireless telegraph station has been built. Never were there two institutions more needed, for this coast is a very Charybdis to passing vessels, or, as Mr. Talbot puts it, "more millions sterling of cargo and ship have been shattered and lost here than on any other corresponding stretch of coast in the world." Just as the lighthouse carried the completest apparatus of its kind, so the Marconi station is a model of up-to-date equipment.

Another interesting chapter in Mr. Talbot's book is that on "The Lamp-posts of the Great Lakes." The enormous cost of safeguarding vessels navigating these waters is little understood, but the fact that £470,000 had been spent on safeguarding Lake Michigan alone up to the year 1883 will give some idea of the immense cost. Even now the latest development in lighthouse engineering is being constructed on Carribean Island, Lake Superior. But the Canadian Government have recognised a cheaper means of safeguarding the shores, and already a chain of Marconi stations is rendering invaluable service to "ships that pass."

Towards the end of his book the writer, without hampering his subject with technical phraseology, gives some excellent descriptions of the apparatus now in use, both in lighthouses and lightships, and one of the paragraphs that interested us most was that on the most wonderful invention of modern lighthouse engineering, the "Dalen" valve, which depends upon the action of the sunlight alone, and automatically lights and extinguishes the light at dusk and dawn respectively. Altogether "Lighthouses and Lightships" affords excellent reading, and can be warmly recommended to any who want to know something of modern invention and progress outside the limits of their own particular fireside and community, but who have not the time to wade through heavy nautical reports, or gather information from the many sources which Mr. Talbot has "tapped" so adroitly.

"ELECTRIC CIRCUIT THEORY AND CALCULATIONS," by W. Perren Maycock, M.I.E.E. (Whittaker & Co., 3s. 6d.)

Luckily for the general public, there are—scattered about the world—many of whom it may be said, "Give him a spanner, an oil-can, and a broken-down bicycle, and he'll coax it to do typewriting for him." These are the men who, after a few minutes, private conversation with a complicated piece of machinery, which may be a total stranger to them, will know, as it were, by instinct, its complete history, its habits, failings, fads and pet tastes, and will be able to tend it, mend it, and even improve it far better than a man who may have been brought up beside it but yet lacks the engineering instinct. But put some of these instinctive engineers in front of a piece of paper containing a few lines of arithmetical calculations relating to that very machine, and it will drive them to a state of acute despair. To such as these, Mr. Perren Maycock's book will prove a real boon so far as electrical work is concerned. We can imagine them seizing on this volume, devouring it eagerly, and then crying out for a companion volume dealing with the mechanical side of their work. The author has managed to put himself into the frame of mind which finds nothing too elementary to explain; and his admirable patience and clearness of exposition should result in a very hearty welcome for his book.

* * *

"TELEPHONE ERECTION AND MAINTENANCE." A handbook for the contractor and wireman. By Herbert G. White. (London: S. Rentell & Co., Ltd., 36 Maiden Lane, Strand, W.C.) Pp. 125 (illustrated). 1s. 6d. net (1s. 9d. post free).

The main object of this book is to explain the principles underlying domestic telephones of the type that the electrical contractor and wireman have to handle, and this object has been kept in view right through the work. No attempt is made to deal with public telephone service; this subject has been ably dealt with by other writers, and is beyond the requirements of the contractor. On the whole, this book should prove interesting and of value to those for whom it was written.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire. His most recent invention is an airship worked by wireless, which is likely to revolutionise aerial warfare. Negotiations are proceeding with the War Office for its purchase from the inventor.*

GWEN THRALE.—*Charles Summers's fiancée, a bright, intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society. She coaxes Summers to teach her "wireless," and soon becomes a proficient operator and a bit of an engineer.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip. They are discovered and "tapped" by——*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly they belong to the leisured and wealthy class; but in reality they are secret agents for a foreign Government sent over to England for the purpose of securing military or naval secrets. Their attention is directed to Summers's work, and they determine to get possession of the airship's plans.*

SIR HENRY DEVER.—*Under-secretary at the War Office and in charge of the department of aerial defence. An energetic man with a keen insight of affairs.*

LIEUTENANT BRAITHWAITE.—*A clever young official, and confidential secretary to Sir Henry Dever. He is sent to Chittingham ostensibly as companion to Charles, but in reality to act as a detective in case anyone should endeavour to tamper with the valuable papers which Charles has in his possession.*

CHAPTER IX.

A STRATEGIC MOVE (*contd.*)

SO now his catastrophe did not touch him. It only left him empty, empty of purpose and idea, as he sat back in the chair and did nothing, thought of nothing—merely lit a cigarette and watched the smoke curling up in fantastic shapes and patterns. Sir Henry, on the other hand, had now become doubly alert. He leaned forward against his desk drumming with a pen handle on the blotting pad, or scratching the white surface of the paper into ridges of miniature mountains with his pen point. All this time Braithwaite was standing practically motionless, only his eyes were alive, and they were bright and eager. It was clear he was taking in the details of the situation with as much interest as his superior. After a time Sir Henry got up, thrust his hands into his trousers pockets, and began pacing the room. Then he became aware of Braithwaite's presence, and curtly dismissed him, adding at the same time, "You had better remain in your office, as I may want you again shortly."

As soon as the door clicked behind the young man Sir Henry turned to Charles. "I suppose you realise, Mr. Summers, that the situation is one of extreme delicacy? I think I shall have to be frank with you, and put the matter as plainly as I can. You are no doubt aware that matters with Germany are in a very unsettled state. It is in all the papers, and every man in the street is talking about it. But perhaps you are not aware that the situation is much more serious than the man in the street even dreams of. In fact, we are perilously near war. It may break out any moment, and I may add—in strict confidence, you understand—that the only reason why we are hesitating to break out into open hostilities

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is that the defences of England are in a chaotic state, and we are quite unprepared to resist any invasion, or even to take the defensive against such a formidable enemy as Germany. That is why the Cabinet is temporising, but we cannot do that much longer, so the only thing to be done is to increase our efficiency in the little time left to us. Of course you know that my department is in charge of the aerial defences, and has to organise everything connected with it. I need hardly say that my hands are more than full; for years things have been hampered for want of money, and now we have to make up arrears as fast as ever we can, so that you can understand that the loss of your invention is a very serious blow to us. I had been counting on it as the only possible means of getting anything like an aerial defence force equivalent to the enemy's. It is hopeless for us to attempt to build 'planes to equal those that Germany possesses. If we were to work for years we could not come up to their aerial strength, and the only hope was that your machine, being of an entirely different type from any that they possess, would make up in quality and prestige for our numerical deficiency; but now it seems that they have got hold of the plans, and it looks very much as though we are checkmated. I think I have got the whole facts of the case in my head, at least as far as I can see, but there are one or two questions I want to ask you. First tell me if you can the whole history of your invention, and how you worked it out. You have mentioned some foreigners. What have they to do with it? Tell me the whole story and try and call to mind *anybody* with whom you have either discussed the thing, or even shown the model."

Charles immediately related the whole history of the building of the airship, not forgetting the episode of the mishap, and as well as he could he described Dupont and Beulner and his acquaintanceship with them, but an instinctive sensibility made him omit Gwen from his account. When he mentioned her at all he spoke of her as "a friend," and took care not to divulge his relationship, but Sir Henry was an astute man, a man of the world, and moreover one born to be a detective. During Summers's recital he said nothing, but afterwards he put a few pertinent questions.

"But have you no copy of your plans?"

"No," said Summers, "I haven't. All I have is a few rough notes—at least, I call them rough, though they are pretty extensive. With careful supervision they could no doubt be worked up. You see I couldn't very well have the specification typed out, as I didn't want to let any outsider in the know, and I did not think it necessary to copy the whole thing out myself."

"Then how about the calculations? Have you all those worked out as well as the notes you speak of?"

"No," said Summers, "I haven't. I thought those were the most likely things to be stolen, or at least, if they were stolen they would be more useful than anything else to the thief, so I destroyed them as soon as I had finished with them. I didn't much like the idea of the old pedlar woman prowling round, and that put me on the *qui vive*, so I am afraid I shall have to work all those out again."

"But I suppose you have most of them fairly definitely in your head? It wouldn't take you very long to make them out again?"

"No," said Summers; "in that way it would be all right. I shouldn't forget anything of that kind."

"Didn't the consulting engineer whom you visited in Queen Victoria Street make many alterations in the paper?"

"No, not many, but those he did do were rather important. It was with regard to the equilibrium of the machine that he did the most, and I don't know whether I can remember them off-hand. I think I should have to consult him again."

After this there was another long silence, which Sir Henry was the first to break.

"Now, Mr. Summers, are you prepared to do all you can to help us? I think I can see a way out of the difficulty, but the extraordinary situation demands an extraordinary procedure; but, first of all, I want you to promise to do absolutely everything I tell you, and what is more important than anything else to ask no questions. But before I say anything more, I want your definite promise."

Of course Charles made the promise, and he was not one to go back on his word, but he little knew at the time how much his word of honour was to cost him.

"Then," said Sir Henry, "I can go ahead,

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and the first thing is—I do not want you to mention the loss of these papers to anyone—anyone at all—and "—with a pause—" not even to your best girl."

He gave a queer glance of scrutiny to Charles and leaned back in his chair to watch the effect. Taken off his guard, the young fellow flushed quickly and made as though he were going to speak, but instantly recovered himself, and thought the better of his intention, so said nothing.

" Also, Mr. Summers," said Sir Henry, quickly changing the subject, as soon as he had found out all he wanted to know, " if you have mentioned any anxiety about these papers, the best thing you can do is to dispel them as soon as you get home. You have got to tell a lie for once and make it clear to everyone that the papers have arrived safely, and that everything is satisfactory. Then, if there is anybody watching the turn of events they will be nonplussed, and we can go ahead. Another thing is, I want you to invite young Braithwaite to your house as a friend. Do you think it will be necessary to mention exactly who he is, or what his purpose is at home ? "

Charles thought that it was not. He could introduce him at Sotheby as an old college chum, whom he had met by chance.

" And I want him to stay with you indefinitely. It's as well that you should have somebody besides yourself to keep an eye on the neighbourhood, and he will do very well as an amateur detective. He has been under me for a number of years, and I can put every confidence in him. As a matter of fact, I think you will find it some relief to have somebody like him to talk to. But what is most important of all, he can keep an eye on such busy-bodies as those pedlars, and see what happens behind your back."

Charles acquiesced, and Braithwaite was ordered to prepare to accompany Charles back to Sotheby that evening, and a telegram was sent off to the Vicarage to announce the forthcoming arrival of his newly found " friend." Gwen was at the station to meet them. She was eager to know the news, and Charles suffered a severe pang of self-reproach when he gave her the lie direct and told her that the papers had been found, and that everything was working smoothly. It went hard against the grain to have to do this, but he felt some solace in quoting Lovelace to himself as a conscience salve :

> I could not love thee, dear, so much
> Loved I not honour more.

Braithwaite was formally introduced to Miss Thrale, and made himself an agreeable companion. He had taken advantage of the train journey to give Charles some idea who and what he was, and already he had assumed the position of a chum. He came of an old Irish military stock. All his family had been soldiers. His father had been killed while he was still a lad in the Matabele war, and he had been brought up by his mother in a far-away corner of County Meath, where the old family house was situated. Parental influence had obtained a commission for him in the Army, and by diligent application to routine work and study he had gained promotion to a position in the War Office, where there was every prospect of his obtaining rapid advancement. He was a special protégé of Sir Henry, and with such a man to back him up there was no knowing what position he might some day occupy. He was by no means a book-worm or an office drudge. He had an aptitude for all kinds of sport, but more especially for horsemanship and billiards. This made him an acceptable member in the clubs, and a good family connection gave him his *entrée* into society. His manner was that of a man accustomed to move in good social circles. He was never embarrassed, always knew how to adapt himself to his surroundings, so that before the evening was out he was already quite at home at the vicarage. A game of bridge and a jolly chat quickly made him one of the family, and the succeeding days only served to strengthen this position. Of course, he was taken to Thrale Hall, and a game of billiards with old Mr. Thrale won that gentleman over completely, so that he was given a hearty welcome whenever he cared to avail himself of it. This was very often, for like any other young man in his position, he found life at Sotheby somewhat flat, especially when Charles was away at work, and perhaps it was not so much Charles's absence that made him seek entertainment at Thrale Hall as the fact of Gwen's presence there. Gwen and he found much in common to interest them, and as the latter aptly described it, they soon became

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"chummy." Often they would go for long rides over the Downs, and there is nothing like a brisk canter and the exhilarating influence of the strong air to make ardent enthusiasts yet more ardent and more enthusiastic, or to cause their companionship to assume the quality of friendship. This increasing *camaraderie* never troubled Charles. He was always glad to see Gwen enjoying herself, and he was much too sure of her affection to suffer any qualms of jealousy. Besides, jealousy was a thing foreign to his nature, so that he could well afford to look on with a rather parental and patronising air.

But to go back to Whitehall and the War Office. On the evening Charles left with Braithwaite for Sotheby Sir Henry Denver was very busy. His telephone was much in request. He had to excuse himself from a social event at which he was due to appear, and instead ring up several officers whose names were often on the public lips. When Sir Henry rang up his calls never passed unheeded, and as a result late that night a little party of high officials met together in his rooms at the War Office to discuss a matter of some urgency. When they were all assembled Sir Henry gave them a concise history of Summers's invention, and the details of the negotiations with the subsequent loss of the plans. Already he had pierced the obscurity and mystery which weighed like a nightmare on Summers's brain. He could account for the presence of the foreigners at Sotheby, and made a shrewd guess at the reason for the pedlar woman's presence within the precincts of the Sotheby Vicarage garden. He also guessed that it was no good trying to recover the lost papers. There was only one thing to be done—that was to get this new airship constructed in the shortest possible time, and before any foreign government could put the plan they had acquired into effect; and further, to run no risk of any future loss of specifications. So he laid his plans before this little committee.

"I have seen Mr. Summers, gentlemen," he said, "and I am thoroughly convinced that he is of too impracticable a nature to be allowed to work without careful supervision. His purpose is entirely honest—so honest, indeed, that he is likely as not to give away secrets without knowing that he has done so. Besides, he is perfectly without suspicion, and I think cannot be left to look after his own affairs by himself. He will, I gather, have to work out a great deal of these lost specifications again, and this may mean some experimental work with his airship. Now, his occupation is fairly well known in Sotheby and the neighbourhood, and there is no doubt—or, at least, it is quite possible—that he may be watched. We must avoid this and prevent any chance of his or our plans being frustrated once again. Another thing is—he must work without interference of any sort, and however well he may be inclined to do this, he cannot in his present circumstances be without interruptions. He has not told me directly, but I was able to gather from his conversation that he has a *fiancée*, or some particular friend in whom he is interested, and such outside influence must detract his attention to some degree, but we have not time to allow him this liberty, and I propose, gentlemen, that the best course to pursue will be to have him arrested. I suggest that he be detained in provisional imprisonment at a naval base, or at one of the Government wireless stations, where he will be given every facility for experimenting and completing his invention; or what would be a still better course, he should be enabled to build an airship after his own type on a full scale, and be given control of a wireless station so that the invention may be put into proper practice with as little delay as may be. There is no knowing how useful this invention is likely to prove, and it is my conviction from what I have been able to gather that it is of considerable moment and likely to revolutionise aerial warfare. You understand the gravity of the international situation at the present moment, and if you will give me your support to my scheme, I propose to communicate with Scotland Yard immediately so that my plan may be carried into effect."

One of the listeners objected that the plan was rather drastic, but Sir Henry replied that the situation compelled prompt measures. Another suggested that Summers should be apprised beforehand of what was likely to happen, but to this Sir Henry would not agree.

"No. I'm convinced that the young

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fellow is engaged, and I do not think him the sort of man to keep such knowledge to himself. I do not say that he would unwittingly blurt out about it, but he would show his dilemma by his looks and acts. The girl—for, as I say, there is a girl in the case—would soon guess something was up, and this is what I want to avoid. If *nobody* knows what is likely to happen there is no chance of the wrong person getting hold of the information, and I think for the sake of security all personal feelings must be sacrificed to the good of the community."

It was felt that Sir Henry was right in his contentions, and it was finally agreed that he should carry out his suggestions. Late that night, therefore, when his colleagues had departed Sir Henry had an interview with one of the heads at Scotland Yard, and the result was a warrant was issued on the person of Charles Summers, engineer, of Sotheby Vicarage, near Chittingham.

CHAPTER X.

"THE COURSE OF TRUE LOVE NEVER DID RUN SMOOTH."

There was no doubt about it. Braithwaite was infatuated with Gwen Thrale, and it was equally certain that for her part the young heiress of Thrale Hall was playing into his hands. Excuses can be made for either side. Gwen was certainly attractive, much too attractive to be the single star of the Sotheby firmament, for it gave her opportunities of making triumphs whenever the chance came her way. Therefore, when so desirable a victim as the clever young aide-de-camp came within reach of her fascination, she was too human, too much a daughter of Eve, to let the golden opportunity slip by. As for Braithwaite, what else could be expected of him than that he should succumb to her charms? Here was an energetic good-looking and smart young man foisted suddenly and by the caprice of fate into a perfect social wilderness as compared with the life he had been accustomed to lead: so the two became more and more "chummy," for Braithwaite had plenty of time on his hands to while away. His duties only occupied him for an hour or so in the mornings, and they seemed to consist chiefly in answering much lengthy correspondence which came to him from the War Office. What this correspondence contained not even Summers himself knew, and the aide-de-camp volunteered no information either by his words or actions, and he had been too well schooled in the game of diplomacy for even the most astute observer to read his face. As a matter of fact all the letters referred to Summers, and his own plan of action in the affair. As soon as matters were definitely settled he was informed of Summers' impending arrest, and he was warned against affording the victim any clue of what was likely to happen. Needless to say he obeyed instructions well. Summers was entirely oblivious of his impending fate. This was not so difficult as it would seem, for Braithwaite, as soon as business was settled, devoted himself entirely to his new sport: that was the ingratiating himself into the affections of a pretty and charming *ingénue*.

This increasing friendship did not remain unnoticed by the countryside, and exercised the united wits of all the village clubs and "charitable" institutions; even it became the subject of discussion at the weekly Dorcas parties, so that eventually, seasoned with gossip, it came to the ears of Miss Summers. It soon took on the proportions of a village scandal, until at last Miss Summers felt it her bounden duty to speak to her brother on the subject. His reception of the news was not very gratifying to her sense of duty and sisterly solicitude, for Charles appeared to take no notice of his sister's report. That might have been expected of him had the subject been one of casual importance, but when it was one which so nearly interested him his nonchalance was a little disconcerting. As a matter of fact his manner belied the true state of his feelings, for he had already noticed the growing intimacy, and his charitable disposition was a little disquieted. Now he felt it was time to raise a protest, but as he was wont to remark, he hated "having rows," so let the matter slide as long as it was possible. At length he was bound to acknowledge even to his loyal soul that things had become "too thick," for he soon found out that whenever he tried to arrange meetings with his *fiancée*, they were usually frustrated by some previously arranged plan; either she was going for a picnic, or Braithwaite was taking her to a dance, or such and such plan had been made without any reference to Charles's wishes or ideas.

(*To be continued.*)

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INSTRUCTION IN WIRELESS TELEGRAPHY

Wireless Telegraph Receivers (II.)

(Eighth Article.)

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appeared on page 461 of the October number.]

UP to the present we have considered the action of the crystal to be purely one of rectifying the oscillatory currents induced across it into uni-directional currents.

58. The crystal can therefore be considered as a conductor offering a certain resistance to current passing through it in one direction, and offering an infinitely larger resistance to current trying to pass through it in the other direction.

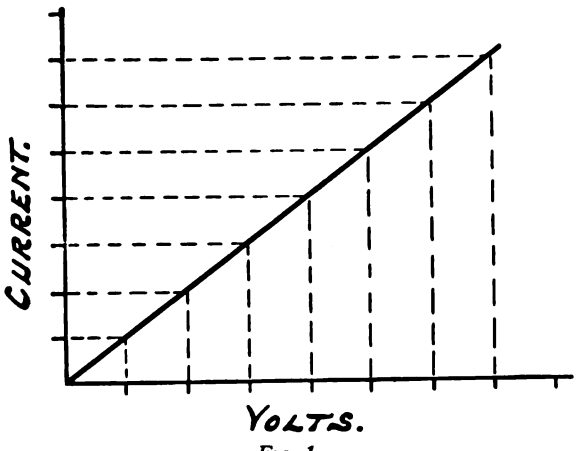

Fig. 1.

Its value as a **sensitive detector,** however, depends upon another property. Even in the direction of conductivity, it does not act in the same way as an ordinary conductor.

With an ordinary conductor the current passing through it increases directly as the voltage applied across it increases. Thus if we draw a "curve" illustrating the increase in the current which would flow through an ordinary conductor as the voltage across it is increased, this curve would take the form of a straight line, as shown in Fig. 1.

If, however, a curve be drawn illustrating the increase in the current passing through a crystal as the voltage across it is increased, it will take the form shown in Fig. 2. In this case it will be noticed that when the voltage is increased beyond the point "A," the current passing through it rises very much more rapidly than before in proportion to the increase in voltage across it.

This is due to the fact that the **effective resistance of the crystal does not remain constant,** but starts to decrease when the voltage across it is increased above a certain value.

By referring to this curve it will be seen that between the point "O" and "A" a certain increase in the voltage across the crystal produces a very small increase in the current passing through it, and thus through the telephones, whereas beyond the point "A" the same increase in the voltage across the crystal produces a large increase in the current passing through it.

To produce a sound in the telephones it is necessary that the current passing through them be increased, and the strength or loudness of that sound will depend upon the amount by which the current is increased.

It is obvious, therefore, that the voltage produced across the secondary coil of the jigger by the oscillatory currents will cause a greater increase in the current passing through the crystal and telephones if it be applied after the point "A" is reached. It is for this reason that a potentiometer is necessary in order to bring the initial voltage across the crystal up to the point "A."

59. Efficiency of Receivers.—In paragraph 57 of the article which appeared in the

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November issue of THE WIRELESS WORLD we mentioned the fact that the efficiency of the receiver depended on keeping the capacity of the secondary circuit as small as possible. The reason for this is that a given amount of energy will produce a greater increase in voltage across a small condenser than across a large condenser.

The energy stored up in a condenser depends upon the product of the amount of electricity with which it is charged, and the pressure at which it is charged.

Let us suppose that we have a certain amount of energy represented by, say, a cubic foot of water at a pressure of 1 lb. per square inch.

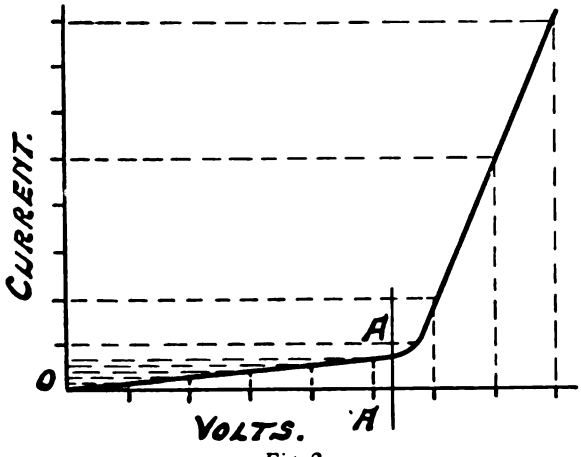

Fig. 2.

It is obvious that half a cubic foot of water at 2 lbs. per square inch will represent exactly the same amount of energy.

In paragraph 17 of the article in the May issue of THE WIRELESS WORLD, in describing the quality of "capacity," we likened a condenser to a football bladder.

So taking this analogy again, if we wish to store this energy in a football bladder we can do it either by forcing a smaller quantity of water, namely, half a cubic foot, into a football bladder of such a size that the walls of the bladder exert a pressure of 2 lbs. to the square inch on the water, or we can force the larger quantity of water, namely, one cubic foot, into a larger football bladder, so that the pressure on the water is only 1 lb. per square inch.

If we force more than half a cubic foot of water into the small bladder the pressure on the water will increase rapidly, as the amount of water forced into it is increased owing to the stretching of the bladder, so that the energy it holds will be increased in two ways: firstly, owing to the greater volume of water which it holds, and secondly, owing to the greater pressure which the bladder is exerting on the water.

It follows, therefore, that for a bladder of a given size, a given amount of energy will only charge it up to a certain pressure. It also follows that the smaller the size of the bladder the greater the pressure to which a given amount of energy will charge it. Thus it is easy to imagine a bladder so small and made of such thick rubber that it would exert a pressure of 100 lbs. per square inch on $\frac{1}{100}$th part of a cubic foot of water, yet it would still hold the same amount of energy as before, provided, of course, that the bladder were strong enough to withstand the pressure without bursting.

So it is with an electrical condenser. The smaller the capacity of the condenser, the higher the pressure or voltage to which it willbe charged by a given amount of energy.

Now in our receiver the power in the circuit is a fixed quantity, depending upon the strength of the oscillations produced in the aerial, which are, in turn, induced into the secondary coil.

It is, therefore, obvious that the only way to increase the voltage across the condenser is to reduce the value of that condenser to a minimum.

In so reducing it we reduce also the wave-length of that circuit, and as it is necessary to keep this in tune with the wave-length which is being received, we must counter-balance the effect of reducing the capacity by increasing the inductance of the circuit. The extent to which we can do this, as already explained, is limited by the fact that every coil of wire has self-capacity, and as we increase the coil to get a greater inductance, so, at the same time, we increase its capacity. The rate at which we increase this self-capacity, however, can be controlled by the design of the coil—that is to say, by its diameter, its length, and the size of the wire with which it is wound.

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A question which will probably arise in the minds of those studying this explanation will be that, in describing the receiver, we said that the crystal was placed across the inductance, whereas in explaining the reason for keeping this inductance high, in proportion to the capacity, we take the point of view that we wished to increase the voltage across the capacity. This is only because it is easier to understand how the voltage must necessarily increase across the condenser if the value of that condenser is decreased, and, since in an oscillating circuit the condenser is connected across the inductance, it follows that the voltage across the inductance is likewise increased.

60. The Use of High Resistance Telephones.—So far we have not touched upon the construction of the telephone receivers.

The function of the telephone receivers, usually called " telephones " for short, is to convert the electrical currents into an audible sound.

It is, of course, of as much importance for this part of the apparatus to be efficient as any other, and in addition to its being made efficient it must be made suitable for the circuit to which it is applied.

A telephone-receiver consists essentially of an electro-magnet and a diaphragm.

The diaphragm is a circular piece of very thin sheet iron, supported all round its edge by the outer case or shell of the ear piece, as close to the face of the magnets as possible without actually coming in contact with it.

Fig. 3 shows diagrammatically a section of a telephone ear-piece where " A " is the iron core of the electro-magnet, B the coils of the electro-magnet, C the case or shell, and D the diaphragm.

Unlike an ordinary electro-magnet, the iron core of the telephone receiver is permanently magnetised.

It is evident then that the diaphragm " D " will normally be strained slightly towards the magnet, as shown by the full line D in Fig. 3.

As already mentioned, it is supported by the shell of the ear-piece all round its edge, but being thin and springy it will bulge in the middle towards the magnet.

61. The action of the telephone receiver is as follows : If a current is sent through the coils in such a direction that the lines of force set up by it assist those of the permanent magnet, the strength of the magnet will be increased and the diaphragm will be attracted still closer to the magnet, thus taking the position shown by the dotted line D_1.

If, on the other hand, a current is sent through the coil in the opposite direction, thus setting up lines of force opposing those of the permanent magnet, the strength of the magnet will be decreased and the diaphragm will be allowed to spring further away from the pole and take up the position shown by the dotted line D_2, owing to the fact that it has already been displaced out of its normal position due to the normal pull of the permanent magnet.

Owing to the form of the diaphragm it acts in just the same way as the head of a drum, and will produce a big sound with a comparatively small displacement of its centre.

Just as the noise produced by a drum will depend upon how hard it is hit by the drum

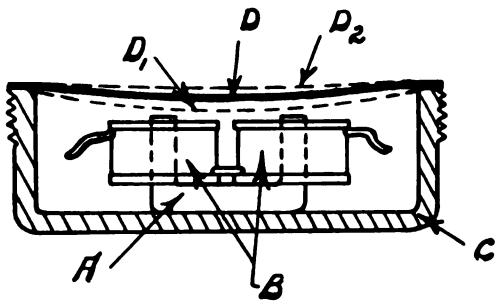

Fig. 3.

stick, so will the noise produced by the diaphragm depend upon the amount of increase or decrease in the magnetisation of the magnet.

It is obvious that the increase or decrease in the magnetism of the magnet will depend upon the magnetisation force or " **magneto-motive force** " which is applied to it.

62. The magneto-motive force depends upon two things : (1) the number of turns of wire which are encircling the magnet, and (2) the amount of current passing through them. The greater the number of turns and also the larger the current the greater will be the resulting magneto-motive force

We may say then that magneto motive force = amperes × by turns.

For a given size of magnet we have only a definite space into which to get our turns of

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wire, so that the only way of increasing the number of turns we can get on is to decrease the size of the wire. The thinner the wire the greater the number of turns which we will be able to get into the space at our disposal.

Unfortunately, however, as we reduce the size of the wire so do we increase the resistance per turn of that wire, and therefore decrease the amount of current which would pass through it for a given voltage. Therefore, unless the current at our disposal is already limited by some external resistances we shall not gain anything by increasing the number of turns if at the same time we increase the resistance of the coil.

If, however, the telephone is in a circuit in which there is already a high resistance, then the increase in the resistance of the coil will not have so great an effect on the total resistance of the circuit and therefore on the current which is passing through that circuit.

For an example, let us suppose that a coil wound with 10 turns of a certain size wire will have a resistance of 1 ohm, and let us suppose that the external resistance of the circuit is 99 ohms. The total resistance of the circuit is then 100 ohms. If our voltage across this circuit is 1 volt, then it follows that our current through this resistance will be $\frac{1}{100}$th part of an ampere, and our magneto-motive force will consequently equal

$$\frac{1}{100} \times 10 \text{ turns} = \frac{1}{10}.$$

Now let us wind the same coil with wire one-tenth the former size. It follows that we shall get 10 times the number of turns—that is to say, we shall get 100 turns of wire on to the coil, but our resistance per turn will be increased ten times.

The resistance per turn in the first coil was $\frac{1}{10}$th of an ohm, so that our resistance per turn will now be 1 ohm; therefore the resistance of the coil will be 100 ohms. Adding this to our external resistance we get a total resistance in the circuit of 199 ohms. Now for the same voltage, *i.e.*, 1 volt applied across this circuit, we shall get $\frac{1}{199}$th of an ampere, and our magneto-motive force will be:

$$100 \times \frac{1}{199} = \text{approx.} \frac{1}{2}.$$

It is obvious, therefore, that we have increased our magneto-motive force nearly five times by winding the coils with a finer-sized wire.

On examining the diagrams of connections of our wireless telegraph receiver, it will be seen that any current passing through the telephones will have to pass through the crystal.

The resistance of our crystal at its most sensitive point is somewhere in the neighbourhood of 10,000 ohms. It will, therefore, be obviously inefficient to wind the telephone receiver coils with such a sized wire that their resistance is only, say, 200 ohms if a finer wire is available.

In practice special telephones are made suitable for circuits with such external resistances. These telephones are wound with the very finest wire which it is possible to manufacture, in order to get the greatest possible number of turns on to the limited space of the bobbins.

Such telephones have a resistance of approximately 3,500 ohms per ear-piece, and two ear-pieces can be used, connected in series, thus making a total resistance of a pair of telephones about 7,000 ohms.

The point which must be clearly understood is that the object of using high resistance telephones is not because they have a high resistance, but because they are wound with a very much larger number of turns than the low resistance telephones, and therefore, owing to the high external resistance of the circuit the magneto-motive force is increased to a greater extent than it is decreased by the reduction of current passing through the circuit owing to the increase of resistance of that circuit.

At the annual meeting of the Gateshead and District Scouts' Association the Hon. Secretary, Mr. R. B. Hindmarsh, reported that a wireless telegraphy section had been formed—the first of its kind in the North—possessing two complete stations which were licensed by the Postmaster-General.

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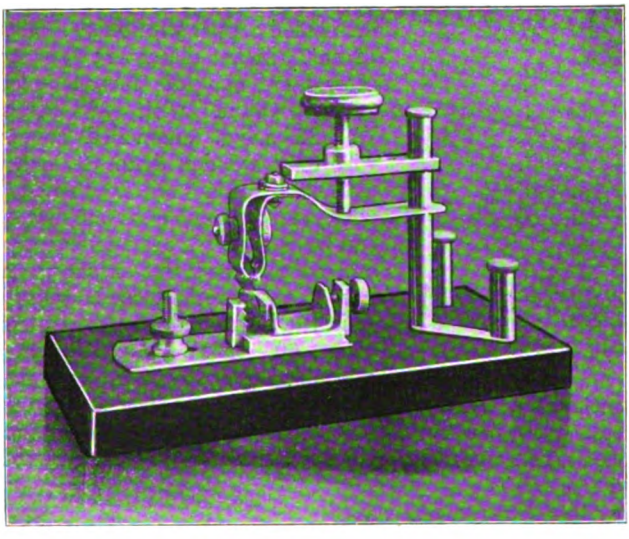
Practical Hints for Amateurs

A Crystal Detector Without Cups

By H. G. EADES



THE crystal detector usually found in an amateur installation is one which has the crystals sealed into brass cups with a metal of low melting point, such as Wood's metal.

The detector here described is home-made, does away entirely with cups, and may be said to have the following advantages :

(*a*) Avoids the troublesome operation of sealing-in.

(*b*) Different combinations of crystals can be used without providing new cups, and, what is more important,

(*c*) Allows *any* part of *either* crystal to be used at will.

The particular advantage of (*c*) will be appreciated by the amateur who knows the difficulty of finding the most sensitive portion of a crystal. Once sealed into a cup, the spot opposing the opposite crystal must always remain the same, whereas in the present arrangement to bring a new portion into play is the matter of a few seconds.

As will be seen from the illustration, the lower crystal is held in a small holder somewhat resembling a horizontal vice. This holder was made by the writer from an old binding screw clamp, the end of which forms one jaw of the vice ; the opposing jaw being made from a thick piece of brass soldered to a plate, which, with two guiding pieces, form the tunnel in which the arm of the holder moves. The end of this plate is turned up, and provides a stop for the tightening screw.

Teeth are filed into the faces of the jaws.

The base plate on which the holder is fixed is slotted, and will move in any direction, the binding screw to the left making fast when adjustment is complete.

The upper crystal is held in a sort of clip. This clip is a continuation of the spring brass arm attached to the supporting standard. Teeth are filed in the ends, and a binding screw holds the crystal quite securely.

The pressure adjustment is made by turning the milled vulcanite screw at the top. The base is of vulcanite.

It will be clear to the reader that the crystals can be rotated with the finger and thumb, by simply loosening either the jaws of the " vice " or the binding screw of the clip. In practice the detector works excellently. The writer has had no difficulty in getting adjustment with all kinds of crystals in the shortest possible time, and the fact that Oran is heard with an aerial only 70 feet long by 50 feet high is surely sufficient evidence of its sensitive nature.

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DESIGN OF A STATION

By J. BARTON

THE station described in this article has been constructed by myself. It is designed on the loose-coupled tuning system, and the following specification, if read in conjunction with the illustrations, will enable other amateurs to construct a similar apparatus with equal success.

Fig. 1.—The Station and its Owner.

Fig. 1 shows a general view of the station (transmitting gear is not shown with the exception of Morse key and mercury break).

Fig. 2 shows the general arrangement and connections of the instruments. In this, A is the leading-in wire from the aerial; B is the wire leading to earth; C is the switch for shorting aerial to earth; D is the switch for connecting the aerial to instruments; E is the aerial and earth change-over switch from sending to receiving; F is the Morse sending key; G is the magnetic key, which causes the current supplying the coil to pass between mercury cups on Morse key being depressed, thus preventing the heavy current burning the contacts; H is the sending helix, composed of 10 turns of ¼-inch copper tubing on a 12-inch diameter frame; I is the spark coil for sending, giving 5-inch spark; J is the motor mercury break for spark coil; K is the starting switch and resistance for motor of mercury break; L is the spark-gap, provided with zinc electrodes—this part of apparatus is placed in centre of sending helix and is muffled, see Fig. 3; M is the high-tension condenser, consisting of 13 sheets of copper foil, 6 inches by 4 inches, interleaved with ½-inch glass plates sealed in paraffin wax; N and O are a two-volt lamp to show when aerial is radiating properly, and switch for shorting same; P is the primary coil of loose-coupled tuner, wound with 50 turns, No. 18 s.w.g. enamelled copper wire on a wooden drum 7½ inches diameter; Q is the secondary coil of loose-coupled tuner, wound with 90 turns, No. 22 s.w.g. enamelled copper wire on a wooden drum 8½ inches diameter. This coil is provided with an overhead slide so that it can be slid away from the primary, and even tipped up, as shown in Fig. 1, an extreme loose coupling; R is the extra inductance, wound with 60 turns, No. 18 s.w.g. enamelled copper wire on a wooden drum 10 inches diameter; S is the change-over switch which enables variable condenser to be put in series or parallel with

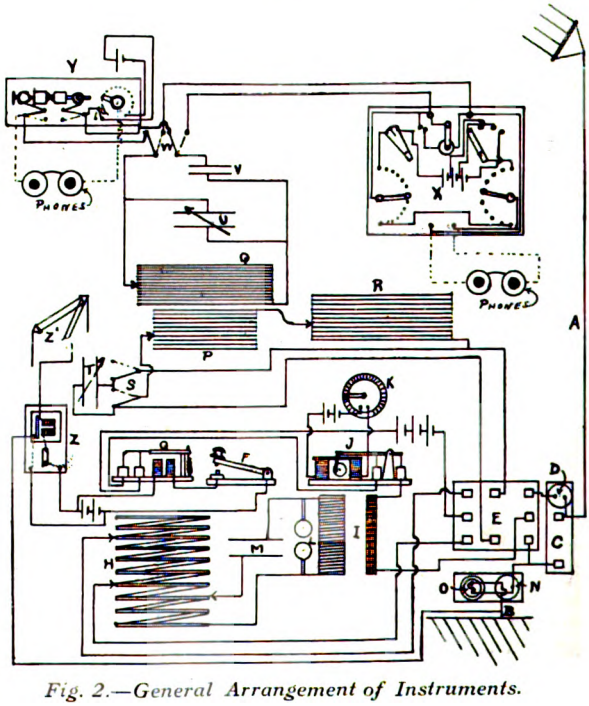

Fig. 2.—General Arrangement of Instruments.

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the primary and extra inductance. For receiving wave-lengths up to 600 metres it is put in series, and from 600 to 4,000 it is placed in parallel; T is the variable condenser for the primary circuit, consisting of 23 moving waves 7 inches diameter working in paraffin oil; U is the variable condenser for the secondary circuit, consisting of 7 moving vanes, 7 inches diameter, working in paraffin oil; V is the blocking condenser, consisting of 7 sheets of copper foil interleaved with waxed paper made in semi-variable, and sealed in paraffin wax; W is the change-over switch which enables either electrolytic or crystal detector to be used; X is the electrolytic detector, with double potentiometer, shunt and battery switches; Y is the crystal detector and potentiometer, which is made from design given in the WIRELESS WORLD, page 208, June issue, with the addition of a switch for cutting out

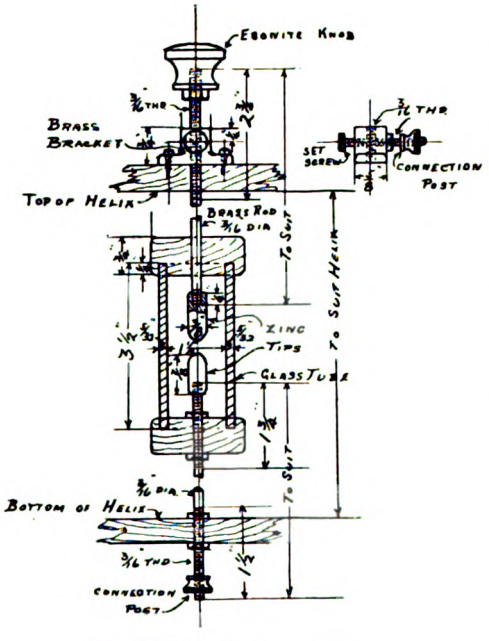

Fig. 3.—Spark Gap Muffler.

the battery when not in use to prevent its running down, and switches for open circuiting detector when transmitting—crystals used are zincite and bornite; Z is the buzzer and buzzer key; Z^1 is the buzzer aerial, which is made as model of outside aerial for appearance only—it can be seen in Fig. 1 just below motor starting switch.

Occasionally the noise of the spark at the spark-gap is very annoying. Those who have a sending helix wound on a hollow wooden frame may overcome this annoyance by making a spark-gap muffler and placing it in the helix. The construction of same can be easily followed from Fig. 3, the

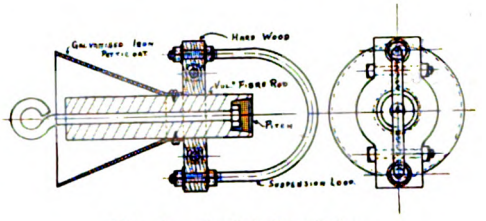

Fig. 4.—Aerial Insulator.

glass tube being $1\frac{1}{4}$ inches inside diameter, $\frac{5}{32}$ inches thick, and $3\frac{1}{2}$ inches long.

A simple, yet reliable, aerial insulator for an amateur to construct is shown in Fig. 4. It consists of a vulcanised fibre rod with a small diameter hole bored through it, and a cup-like recess at one end. A metal rod runs through this hole, and a nut is placed on one end and rests in the cup; the cup is then filled in with pitch. The whole tube is clamped between two pieces of oak about 1 inch thick, to which the suspension loop is fastened. A galvanised iron petticoat may be attached to further lessen the possibility of leakage. I use three of these insulators at each end of my aerial, and they give perfect results. The aerial used in conjunction with this set of apparatus consists of two 12 s.w.g. aluminium bare wires, 85 feet long, suspended 6 feet apart, at a height of 45 feet above the ground.

The programme of lectures for the winter session of the Montreal Electrical Society includes a lecture by Mr. A. E. Reoch, of the Marconi Wireless Telegraph Company of Canada.

His Majesty King Albert of Belgium recently visited the stand of the Antwerp Telephone and Electrical Works at the Ghent Exhibition, and was greatly interested in the Marconi Wireless Telegraph Apparatus exhibited. His Majesty graciously accepted two knapsack stations for his sons, Leopold, Duke of Brabant, and Charles Theodore, Comte de Flandre.

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Wireless Time Signals

SO many watch and clock manufacturers, besides amateurs, now listen to the wireless time signals given from the Eiffel Tower, in Paris, that a possible decision of the Postmaster-General to impose a tax on so doing will cause widespread interest and possibly some resentment.

In a letter to Mr. F. Hope-Jones on the subject, Mr. E. W. Farnall, on behalf of the Postmaster-General, wrote on October 20th as follows :

" With reference to your letter of July 17th last and subsequent interviews on the subject of licences for the reception of time signals by wireless telegraphy, I am directed by the Postmaster-General to inform you that, although the conditions upon which such licences can be issued have not yet been definitely decided, it is probable that an annual royalty may be charged, in addition to the fee of £1 1s. already asked for in respect of the expenses involved in the issue of the licence. Licences cannot be issued until a decision is arrived at, but meanwhile applicants are being authorised to proceed with the installation of their apparatus, provided that they will make a deposit of £3 3s. (or £2 2s. if the fee of £1 1s. has already been paid), and will undertake to conform to the conditions of the licence when it is issued, or to dismantle their apparatus without delay should they find themselves unable to accept the conditions. The deposit will be refunded should they decide not to proceed with their application."

Mr. Hope-Jones replied that the watch and clock makers of other countries are freely permitted to listen to the international time signals, and any attempt to restrict their reception in this country would be detrimental to the science of accurate time measurement, and would put the British watch and clock makers at a disadvantage to their foreign competitors. He also pointed out that the international wireless time signals interfere in no way with the Post Office system of telegraphic time signals for the synchronisation of clocks.

Major E. H. Hills, F.R.S., in a letter which appeared in the *Times* on November 12th, appealed to the Postmaster-General " to hesitate before he attempts such a retrograde step." He adds :

" I need not here enter into the history of the establishment of this time service beyond saying that it is the outcome of an international conference held at Paris, that it has been welcomed by scientists, including the Astronomer Royal, and that it is in no sense competitive with the time service of the Royal Observatory, Greenwich.

" These signals will be of great value both to clock and watch makers and to astronomers and owners of observatories, while it is hoped by many that their use will be found so simple that an apparatus for receiving them will become part of the equipment of every village and of many country houses.

" Besides these utilitarian applications there is at present an inducement for boys of a scientific turn of mind, sixth form boys on the science side in schools and young electricians in technical colleges and universities, to construct apparatus for themselves and listen for these strong signals. Even some detachments of Boy Scouts have, I am told, little field apparatus. To impose an annual tax upon all receivers would, to a large extent, strangle the use of these signals as far as this country is concerned. I am not entitled to speak on the legal aspect, but it is at least doubtful whether an apparatus for receiving only is a ' wireless station ' or ' installation ' within the meaning of the Act of 1904.

" However this may be, it is a sound principle of legislation not to make laws or regulations which cannot be enforced. The receiving apparatus for strong signals is of so simple a nature that evasion of the tax would present little difficulty. Thus, in any case, it would probably be ultimately collected from only a small proportion of the users."

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AMATEUR NOTES.

"Words" over "Wireless."

OUR contemporary the *English Mechanic* has recently been holding in its correspondence columns some heated controversies on the subject of Wireless Telegraphy. We particularly like the severe tone of "Radio-Telegraphist," who writes: "In reply to 'W.N.' (letter 352), I regret to see he chooses to uphold a very obvious error. An inductance of 80 millihenries is about eight times too much for Clifden, and, so far as wireless waves are concerned, it is a practical impossibility. . . . The aerial inductance of a Marconi Multiple-Tuner designed to take Poldhu is only *four* millihenries." He ends with the caustic remark, "But perhaps 'W.N.' is a new reader." After this, we cannot help hoping that "W.N." will "get some of his own back."

In the first place, since the wave-length of Clifden is more than twice that of Poldhu, the aerial inductance required would be about four times that required for Poldhu; so that, even on "Radio-Telegraphist's" own showing, 80 millihenries could hardly be "eight times too much." If this were all, however, "Radio-Telegraphist" would appear to be nearer the mark than "W.N."

* * *

We have not seen the discussion from its beginning, but we gather that "W.N." was referring, not to aerial inductance, but to jigger-secondary inductance. The latter can in no way be compared with the former; for the aerial inductance is combined with the capacity of the aerial, while the jigger-secondary is combined with whatever variable capacity may be placed across it. Since the relation of this capacity to the inductance varies—for best results—with the nature of the crystal which is in use, it is impossible to say what is the best value for the inductance of the jigger-secondary. One thing, however, is certain: using high resistance crystals such as silicon or carborundum, an inductance of from 80 to 100 millihenries gives, for the reception of Clifden waves, a very suitable value for the capacity across it, and forms an excellent jigger-secondary.

Another interesting controversy, already far advanced it would seem, deals apparently with the working of certain wireless schools in the neighbourhood of London. We gather from the letter of "C.Q." that certain amateurs have been worried by interference caused by the learners at these schools transmitting too diligently. Indeed, "C.Q." goes so far as to state, with every appearance of responsibility, that "there is no doubt that the transmitting of these schools is a serious nuisance, and not to amateurs alone, and the matter can hardly remain where it is." It would appear that these schools are having the audacity to use the magnetic detector, instead of some of the innumerable crystal receivers, about which we receive every month so many questions as to the eccentricities of their behaviour. We rather gather that the frame of mind of those correspondents who are protesting against the conduct of these schools is this: "If I, by careful adjustment, can receive signals on my chalcopyrite-molybdenite crystal—quite five times out of ten—without missing more than a few words now and then when my crystal goes out of adjustment, why should there be any need for anyone else to use the magnetic detector, which is undoubtedly less sensitive, and therefore requires stronger signals which interfere with my experimenting?"

* * *

No readers of THE WIRELESS WORLD can think for a moment that we do not appreciate the importance of the Amateur; nevertheless, we cannot come across such an attitude as this without making an earnest comment. The learners, whose practice in the duties of commercial wireless appears to be interfering with the experiments of these correspondents, are taking up wireless seriously as a profession; in a short time, perhaps, they will be in charge of the wireless plant of some big liner, and on their efficiency and nerve and self-forgetfulness may depend the lives of hundreds. Have not they, then, a thousand times the prior claim on the ether? Is it "good form"—to say the least of it—for an amateur who is often merely amusing himself in his spare time to try to "put his spoke in their wheel"? Or—looking at it in a lighter spirit—is it not rather like the old Major who has missed his putt and, pointing furiously to the far

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horizon, exclaims furiously, "How the —— can one be expected to putt with those —— ships sailing up and down?"

* * *

We have no doubt that those who are responsible for the schools in question are quite capable of defending themselves; we have no intention of taking up cudgels on their behalf, but we feel prompted to give our opinion on the controversy, as it strikes us. Leaving aside for the moment all questions of ethics and dealing only with hard facts, it seems to us that "C.Q." has not a leg to stand on. One thing is certain: if these schools are transmitting with "40 to 50 watts antenna energy," they have obtained a licence from the Postmaster-General to use that amount of energy; that is to say, they have convinced the Postmaster-General and his experts that the use of such power is justifiable. In spite, therefore, of "C.Q.'s" remark that "the matter can hardly remain where it is," there seems every possibility of it remaining where it is unless "C.Q." can convince the Postmaster-General that his decision was wrong. And as a first step towards doing this, "C.Q." must be in a position to show that he realises the difference between what is necessary for experimental "reception," and what is necessary for commercial wireless, where the missing of a single word may render a message valueless, and might—in the extreme cases which have to be allowed for by those who devote their lives to the cold science—render a call for aid entirely fruitless. If "C.Q." points to a receiver which has saved a tithe of the number of lives which the magnetic detector has saved—in spite of the fact that it does not claim to be so sensitive as the other receivers of the Marconi Company, or as the "freak" crystal receivers which offer such attractions for experimental work—he would at least be doing something to justify the patronising tone which he employs towards the most superbly reliable instrument in use in "Wireless."

* * *

An interesting fact, concerning which "C.Q." is in all probability ignorant, is that in cases of shipwreck it is often necessary to use what is called the "Emergency Set," which sends out the call for help in powerful, highly-damped waves, well calculated to arrest the attention of every ship within a large radius; and for the reception of such waves the magnetic detector is particularly well adapted, apart from the fact that it would be in perfect working order after a shock, which would put every crystal-receiver ever conceived out of adjustment, and might shatter even the highly-perfected Marconi valve-receivers.

It is being proposed to form a wireless club in the Potteries, to be called the Stoke-on-Trent Wireless Club. All those interested and desiring to join the above club should forward their names and addresses to Mr. F. Pamment, 349, Florence Terrace, The Meir, Longton, Staffs.

* * *

A Wireless Association has been formed at Bristol, and the secretaries are Mr. K. W. Cox, of 16, Edgecumbe Road, Redland, and Mr. N. M. Driver, of 13, Claremont Road, Bishopston, Bristol. At a meeting held on November 15th, over which the Rev. W. P. Digby presided, it was announced that some interesting papers would be read during the ensuing session.

* * *

A meeting was held recently in Leeds, at 22, Blenheim Terrace, Woodhouse Lane, by a number of telegraphists, electricians, etc., who are interested in wireless telegraphy, whereat it was decided to form a club called "The Leeds and District Wireless Club." Office bearers were elected as follows:—J. R. Cyril Hillman, C.E., President; J. W. O. Donohoe, Treasurer; A. M. Bage, Hon. Secretary, 4, Warwick Place, Leeds.

* * *

The Derby Wireless Club and Derby Society of Model Engineers are holding a joint exhibition on wireless apparatus, working models, etc., in the Mechanics' Institute, Derby, on Wednesday, December 3rd, which will be open from 4 to 10 p.m., and the respective organisations will welcome the presence of amateurs from other towns.

Other Club Notes are unavoidably held over.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

L. D. L. (Macclesfield).—My aerial has a natural wave-length of about 400 metres and I wish to shorten it to transmit on a 300 metre wave. Can this be done by inserting a variable condenser instead of a variable inductance in the open or aerial circuit.

Answer.—Yes; it is necessary to reduce the capacity of the aerial by putting another condenser in series with it; it need not necessarily be a variable one—a variable condenser which will stand the voltages of transmission would be a difficult thing to make. You could build up a fixed condenser of glass and zinc plates, making it once and for all of the right value to tune the aerial and jigger-secondary to the right wave. The introduction of this condenser means that your aerial will normally be insulated from earth, so that for protection from lightning you should have a short-circuiting plug which you can put in at any time. If you are devoting yourself to the 300 metre wave communication, it would pay you to reduce your aerial till it gave the right wave; but we suppose you wish to keep it at its full length for long-distance reception.

E. A. E. (Lymm).—My twin-wire aerial gives a natural wave-length of about 300 metres. As I am only allowed a 200 metre wave for transmitting how I am to use 200 metres without altering my aerial? I also want to receive on 200 metres without dimming signals in any way. Will you also give dimensions for a transmitting jigger to use with a ½ inch spark coil with the above aerial (poles 150 feet apart, average height of horizontal portion 40 feet, lead-in of 40 feet from one end.)

Answer.—If you are going to use your aerial entirely for the 200 metre communication, it will pay you to shorten the aerial length—by introducing a suitable length of rope at the lower mast—until it gives you the 200 metres when put in series with your transmitting jigger-primary. If you want to use it also for long-wave reception, and therefore wish to keep it at its maximum length, you will have to reduce its capacity by putting a condenser in series with it, both for tranamission and reception. If you have a wave-metre, this is not a very difficult job, but it is better to avoid it if possible as it interferes to some extent with the efficiency. As for your transmitting jigger, the particulars of this depend on the particulars of your coil. You want to make your transmitting condenser of as large capacity as possible without reducing your spark too much, say, not below 1 mm. Therefore the size of your condenser cannot be fixed until you know the capabilities of your coil—the fact that it is a ½ inch spark coil does not specify its qualities sufficiently. Until the capacity of your condenser is fixed, you cannot say what the inductance of your jigger-primary should be in order to give you the 200 metre wave. Find out what inductance you want and then design your primary accordingly; and proportion your secondary to fit this. A usual ratio for the number of turns in secondary to number in primary is 7 to 1. A 4 inch diameter former would probably suit you for the secondary.

W. B. (Cheltenham) asks for the design of an aerial. He is able to have a 40 foot pole with a short lead-in as he is hemmed in by houses.

Answer.—Could you not make use of a chimney or two belonging to your neighbours' houses? If so, try and get some form of T aerial; but the cross of the T need not be exactly in a straight line. Run up two wires from your receiving-room to a light spreader (say 5 feet long) at the top of your mast, and from the spreader carry them, still parallel to each other, to another spreader fastened to a chimney, if possible. This gives you the upright of the T and one-half of the cross; the other half is provided by two more wires from the same spreader, in electrical connection with the first half, taken to another spreader fastened to another chimney, somewhere opposite to the first. Or you can simplify matters by using a single-wire T instead of the "twin" described above. Take care to keep each half of the cross of the T equal in length. In the case of the "twin," the wires should not be joined at the far ends. Insulate the aerial at every point of suspension. Make sure you have a good earth and never leave your aerial un-earthed. If you cannot use the chimneys you must bring the ends of the cross to light lines fastened to pegs in the ground, but do not bring the ends of the cross too near the ground. You might also try a simple vertical aerial of the "sausage" shape, say 5 equal wires disposed round three child's wooden hoops.

It is necessary to obtain the Postmaster-General's licence for a receiving station.

J.A. (Aberdeen) proposes to instal a receiving station and asks for information regarding tuning coils and 'phones. He can get an aerial at an average height of 50 feet, length 80 to 100 feet, two wires 24 inches apart, the earth wire being connected to water pipe.

Answer.—You could get quite good results with a two-slide coil, no variable condenser, only a fixed condenser (or better a condenser which can be varied in two or three steps) and the aerial earth and telephones which you mention. You would get better results, greater selectivity for instance, with three sliders, variable condensers and a more complicated circuit generally.

F. H. T. (Eastleigh).—(1) I want to use an ordinary telephone receiver about 500 ohms resistance. Can I connect a 500 ohm resistance coil across the terminals of the 'phone; if so, would this answer the same as rewinding the coil in the receiver to 1,000 ohms? (2) Should the connecting wires between instruments and earth plate be insulated? (3) I have a tuning coil primary 5½ inches diameter by 10½ inches long, and secondary 4⅜ inches diameter by 9 inches long, wound with No. 22 S W G: D C C wire; secondary sliding inside of primary. Using an aerial 40 feet long by 40 feet high, what stations ought I to "pick up"?

Answer.—No. See reply to H. C. B. (No. 3) in this issue. (2) Not important; it is as well to insulate them till they are clear of the receiving table. (3) So far as the inductance of your primary coil is concerned you ought to be able to tune to all stations up to 3,000 metres wave. You can make the secondary tune to anything by putting a suitable small variable condenser across it.

W. J. B. (Tipton).—Sorry, but we feel inclined to refer you to our Irresponsible Expert's reply to N. Parker (Lowestoft) in the November number. Seriously, yours is not a suitable question for these pages.

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F. G. L. (Newbury) has been coming up against the phenomenon that his wireless transmission gets received —unintentionally—on neighbouring telephone-circuits, and he is puzzled to explain this because he believes "it requires a rectifying detector to make alternating currents work a telephone, and there is certainly nothing of the kind in the ordinary telephone." As it stands, this statement is not at all correct; alternating currents will work a telephone admirably; in fact, they are just what a telephone likes; it is only when they become so rapid as to be really "high-frequency" or oscillating currents that they fail to affect the telephone, partly because the impedance of the coils is too great to allow them to pass, partly because the diaphragm cannot keep up with them, and partly because the ear cannot hear so high a note. F. G. L.'s waves, which he sends out to his other station, are certainly high-frequency; but if he is using "plain aerial" (see Instructional Articles, or Year-Book Glossary) he is charging up his aerial to a certain high voltage every time his coil-trembler breaks contact—which is just a suitable number of times per second to suit a telephone—and his aerial is inducing a corresponding effect on the telephone wires below it. It is not radiation, but induction, which the telephone circuits are picking up in this case. But this is not the only way in which wireless signals can affect an ordinary telephone-circuit. Practically every telephone instrument comprises a receiver and a microphone-transmitter. The carbon granules of the latter are quite capable of acting as coherers, and would thus be affected by the true high-frequency currents picked up by the telephone wires from the energy radiated from a wireless aerial, letting the current from the telephone-batteries through the receiver just as the vibrations caused by the voice let it through.

H. C. B. (Norwich).—(1) Does the crystal detector act as a valve to the oscillating electricity? (2) Why is it that a battery has to be used with some detectors? Is it because the crystals have no rectifying effect unless a small current is passing through them? (3) Why must the 'phones have such a high resistance? (4) What is the effect of damping the oscillations in the transmitting circuit? Does this affect the range of the station? Why does it not matter having the oscillations in the receiving circuits highly damped?

Answer.—Far too many questions at once. We can only reply to the first four in this number.

(1) It is rather that the crystal acts as a valve allowing one-half of the wave to pass and charge up the condenser, but refuses to allow the following half—which is, of course, in the contrary direction—to pass and neutralise the effect of the first half.

(2) This "rectifying" effect of the crystal is due to the fact that its current-voltage curve is not a straight line (as it would be if it obeyed Ohm's Law) but a curve with a sharp bend in it. To obtain the most sensitive effects we must work the crystal at this bend, and, as in the case of many crystals—most carborundum crystals, for example—the bend comes some little way away from the point of zero voltage, we must apply a carefully regulated constant voltage so that the signals may have a "start," as it were, as far as the bend of the curve.

(3) The actual resistance of the 'phones affords no advantage, but rather a disadvantage. It is merely the custom to speak of 'phones being "high-resistance" when we mean that their coils have a large number of turns (which means great sensitivity for small currents) because a large number of turns in a small space implies fine wire and high resistance. This point does not seem to be at all well understood; we have known people deliberately wind their telephones with resistance-wire so as to obtain the high resistance.

(4) It means less waves in each wave-train and therefore less cumulative effect in the receiving circuits: which leads to flat tuning and loss of selectivity. See article on "Syntony" in the Year-Book for 1913.

E. R. FF. W. (Leeds).—The effect of the method of construction of the Quenched Gap is to restore the non-conducting character of the gap the first time the closed circuit comes to rest, and thus leave the radiating circuit to oscillate in its own period. How would it be possible to take photographs in both circuits to determine whether this is so?

Answer.—Rather too intricate a matter to deal with fully in these columns. The best method is to use a very special form of vacuum tube in which alternating or oscillating currents produce a glow, the actual length of which is proportional to the current passing. This tube would be placed across the condenser of the oscillating circuit, and the glow viewed or photographed after reflection in a rapidly rotating mirror.

There are various complications, such as the necessity for timing the mirror revolutions to suit the discharge-frequency; the whole process is tolerably simple for very long waves with their consequent low frequency, but becomes very difficult with short waves.

W. I. (Watford).—I notice in your October number, in your reply to R. J. H. B., you say, "the free ends should not be joined together as you show them." This is my difficulty. Some books say that the ends should be open, and some clearly indicate them joined. Will you kindly tell me whether my antenna is correctly made? It seems to work well, but possibly might work better.

Answer.—You give the length of your aerial in your sketch, but do not mention the width; from the drawing it would appear almost square. If this, by any chance, is the case, the whole arrangement as you have it resembles an elevated capacity (like a Lodge aerial) more than an ordinary aerial, and probably the fact that the down-lead comes off quite unsymmetrically from one corner would have no serious effect; similarly with the fact that the ends are joined. But if this square effect is only a mistake in the sketch, and your aerial is an ordinary one, very long in comparison with its breadth, then you should certainly leave the far ends free and take care that the length from each free end to the receiving apparatus is exactly the same; preferably all the wires should remain insulated from each other until they join to enter the receiving-room.

BAFFLED.—In my private installation I have a transmitting jigger of the following dimensions: Primary: 4 turns, ¼ inch copper pipe, 6½ inches diameter, turns 2 inches apart. Secondary: 7 turns, 5½ inches in diameter, No. 16 gauge copper wire, turns ½ inch apart. I find that on charging a ·075 mfd. condenser with a 10-inch spark coil, and discharging through primary, I get no effect whatever in the secondary circuit. The primary circuit has been carefully tuned to 300 metres, and also the secondary, but when the two are coupled together I get no effect in the wavemeter, a Marconi portable. Can you tell me my error or offer any advice for its improvement?

Answer.—It is almost impossible for us to deduce what is happening unless you send us a diagram of connections. Your description of your method of procedure might be read in so many ways. You "charge up a ·075 mfd. condenser with a 10-inch spark coil" and "discharge it through primary." It is to be presumed that this means the ordinary discharge through a spark-gap, but no spark-gap is mentioned. If the gap has been omitted you naturally would not get any effect in the secondary. But we can hardly think that this is the solution. At the same time, we should like to know something about the nature and length of the gap. But what is even more puzzling is the combination you give of a ·075 mfd. condenser and a 4-turn primary, 6½ inches diameter, to give a 300 metre wave. With such a condenser the inductance necessary to give 300 metres would be about one-third of a microhenry, and we should say your primary—apart from leads to spark-gap, etc.—would be about 1¼ microhenry. So we do not see how your primary circuit can be accurately tuned up to 300 metres.

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Catalogue of Books on Wireless Telegraphy

ASHLEY.—*Wireless Telegraphy and Telephony (including Wireless on Aeroplane and Airship).* By Chas. G. Ashley, E.E. Treating in a simple, concise manner on the earlier forms of wireless, electrical waves, development of radio-telegraphy, radio-telegraphic apparatus, and describing the systems of radio-telegraphy. Contains 144 pp. 4s. 6d. net.

BOTTONE.—*Wireless Telegraphy and Hertzian Waves.* By S. R. Bottone. Fourth Edition, revised. With 39 illustrations, 148 pp. Crown 8vo. 2s. 6d. net (postage 3d.).

ERSKINE-MURRAY.—*Wireless Telephones and How They Work.* By James Erskine-Murray, D.Sc., F.R.S.E., M.I.E.E., Lecturer on Wireless Telegraphy and Telephony at the Northampton Institute, London; Fellow of the Physical Society of London; author of *Wireless Telegraphy*, and translator of Herr Ruhmer's *Wireless Telephony*. Second Edition, revised. 76 pp. With illustrations and two plates. Crown 8vo, cloth. 1s. 6d. net.

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FLEMING.—*The Principles of Electrical Wave Telegraphy and Telephony.* By J. A. Fleming, M.A., D.Sc., F.R.S., second edition. 300 pp. illustrated. 28s. net.

FLEMING.—*An Elementary Manual of Radio Telegraphy and Telephony.* By J. A. Fleming, M.A., D.Sc. F.R.S. 340 pp. illustrated. 7s. 6d. net.

FLEMING.—*The Wonders of Wireless Telegraphy Explained in Simple Terms for the Non-Technical Reader.* By J. A. Fleming, M.A., D.Sc., F.R.S., etc., University Professor of Engineering in the University of London. With 60 illustrations and diagrams, 280 pp. Large crown 8vo. 3s. 6d. net.

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HADLEY.—*Magnetism and Electricity for Beginners.* By H. E. Hadley, B.Sc. (Lond.). Adapted to the Elementary Stage of the South Kensington Syllabus. Globe 8vo. 2s. 6d.

HAWKHEAD.—*Handbook of Technical Instruction for Wireless Telegraphists.* By J. C. Hawkhead. 294 pp., 249 illustrations and diagrams. 3s. 6d. [This is the latest book published on the subject of wireless telegraphy. It is a sound and trustworthy guide through a course of instruction on wireless telegraphy, which should enable the diligent reader to qualify for the Postmaster-General's certificate.]

HERTZ.—*Electric Waves.* By H. Hertz. Translated by D. E. Jones, B.Sc. Second Edition. 8vo. 10s. net.

LEE.—*The Economics of Telegraphs and Telephones.* By John Lee, Traffic Manager, Post Office Telegraphs. In crown 8vo, cloth gilt. 2s. 6d. net.

LODGE.—*Modern Views of Electricity.* By Sir Oliver Lodge, F.R.S. Third Edition, revised and enlarged. Illustrated. Crown 8vo. 6s.

MARCHANT.—*The Radio-Telegraphists' Guide and Log-Book.* A Manual of Wireless Telegraphy for the use of Operators. By W. H. Marchant. With 90 illustrations, 200 pp. Pocket size. 4s. 6d. net (postage 3d.).

RUHMER.—*Wireless Telephony in Theory and Practice.* By Ernst Ruhmer. Translated from the German by J. Erskine-Murray, D.Sc., M.I.E.E., etc., author of *A Handbook of Wireless Telegraphy.* With numerous illustrations. Demy 8vo, cloth. 10s. 6d. net.

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The above and other electrical books, English and foreign, can be obtained at the published prices from the Marconi Press Agency, Marconi House, Strand, London, W.C., on receipt of remittance to cover cost of postage. On orders amounting in value to £1 and over the books will be sent carriage paid in the United Kingdom.

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Patent Record.

The following patents have been applied for since we closed for Press with the October number of this magazine:

No. 20,521. September 11th. Arthur B. Williams and Wm. A. Solomon. Rotary interrupters or contact breakers, and similar devices for, in connection with wireless telegraphy and like installations for analogous purposes.

No. 20,798. September 15th. Marius Paul Otto. Process and apparatus for establishing synchronisation by means of electric waves.

No. 20,806. September 15th. Frederick Miller. Apparatus for the production and radiation of electrical oscillations.

No. 20,937. September 16th. William H. Wilson. Production of high tension discharges.

No. 21,212. September 19th. Marius Paul Otto. Apparatus for manœuvring at a distance marine or aerial torpedoes or other engines.

No. 21,672. September 25th. Marconi's Wireless Telegraph Co., Ltd., and Richard N. Vyvyan. Improvements in the connections of electrical condensers.

No. 21,732. September 26th. John R. Pickford. Microphones, transmitters, detectors, and the like.

No. 22,220. October 2nd. Arthur B. Williams and Wm. A. Solomon. Electro-magnetic relay for use in connection with wireless telegraphic installations and for other purposes.

No. 22,437. October 6th. Frederick J. Chambers. Radiotelephony.

No. 22,537. October 6th. John G. Balsillie. Wireless Telegraph transmitters.

No. 23,113. October 13th. Henri Abraham. Receivers adapted for wireless telegraphy.

No. 23,340. October 15th. Marconi's Wireless Telegraph Co., Ltd., and C. P. Ryan. Means for operating gas valves from a distance.

No. 23,557. October 17th. Marconi's Wireless Telegraph Co., Ltd. and C. S. Franklin. High-frequency alternators.

No. 23,728. October 20th. Signal Gesellschaft, M.B.H. Radiating system for signalling by electric waves from aeroplanes.

No. 24,148. October 24th. Marconi's Wireless Telegraph Co., Ltd., and A. Gray. Masts.

No. 25,085. November 3rd. Thomas D. Smith. Telescopic radio-telegraphic masts.

No. 25,434. November 7th. Frank P. W. Allen. Wave detector for wireless telegraphy and telephony.

No. 25,612. November 8th. Ivor Scott Winby and Reginald Garrett. Wireless telegraphy.

Personal Items.

Sir William Crookes, O.M., has been elected President of the Royal Society.

Capt. P. B. Coulston and Lieut. W. Bottomley, Western Wireless Signal Company, Royal Engineers (T.F.) have resigned their commissions.

Mr. W. Llewellyn Preece, who recently underwent a serious operation, is, we are glad to state, making satisfactory progress.

Capt. A. M. Deacon, R.M.L.I., has been appointed to the *Impregnable* as Instructor of Wireless Telegraphy and for command of Royal Marine Detachment.

Mr. Herbert B. Tilley, A.M.I.E.E., of Marconi's Wireless Telegraph Co., Ltd., Chelmsford, was married recently at the Wesleyan Chapel there to Miss Winifred Norris, daughter of Mr. and Mrs. J. A. Norris, Mount Pleasant, Chelmsford. Mr. Tilley was for a number of years connected with Messrs. Bruce Peebles & Co., Ltd., of Edinburgh. Among the many presents received were a clock from "old friends" at Bruce Peebles, table silver from the employees of Messrs. Christy & Norris, Chelmsford, and also presents from the staff of the Marconi Company. A unique notification of the wedding was the hoisting of a Union Jack to the top of one of the high Marconi poles (500 feet) immediately after the ceremony.

Obituary.

Sir Robert Hunter died on November 6th at Haslemere in his 69th year. For over thirty years he was solicitor to the Post Office, and in his official position he came in contact with the negotiations in connection with the Imperial Wireless Scheme.

We regret to record the death of P. L. Brownfield, an operator in the service of the Marconi International Marine Communication Co., Ltd. Mr. Brownfield at the time of his death was operator in charge of the s.s. *Letitia*, and he became ill with typhoid fever on a recent voyage, and on arrival of the vessel at Montreal he was taken to the General Hospital in that city where he died some days later. During his illness on board the s.s. *Letitia* Mr. Brownfield was well looked after by Captain McNeill and other officers of the vessel. Mr. Brownfield was in his twenty-fourth year. He joined the Marconi company as a learner in March, 1910, and he served on several other vessels before taking up his duties on the *Letitia*. Prior to joining the company's service he was employed as a telegraphist in the Central Telegraph Office, London. He received his training at the British School of Telegraphy. Mr. Brownfield was a popular officer, and his early death is deeply regretted by his many friends and acquaintances among the operating staff. He was buried at Montreal on October 17th. Every ship in port was advised by Captain Gillis, and practically every ship was represented at the funeral by its Marconi operator. It was gratifying that the Marconi operators responded so readily to the call, and at least twelve men in uniform were present with Mr. J. H. Lauer, general manager of the Canadian Marconi Company office staff. The casket was covered by the Union Jack and two beautiful wreaths, one of which was sent by the staff of the Canadian Marconi Company.

Horace Toon, who was employed in the Transfer Department of Marconi's Wireless Telegraph Company, died on October 23rd. Although deceased has not been long associated with the company, his engaging personality endeared him to all with whom he came in contact, and by whom his early death is deeply regretted.

An electrician employed at the Arlington government station, U.S.A., O. L. Clark, died recently as the result of injuries received when he fell against the sparkgap disc, making 1,250 revolutions a minute. Clark was alone in the room. The power had just been closed down, but there was enough current from the disc to inflict fatal injuries. The operator was a man of several years' experience.

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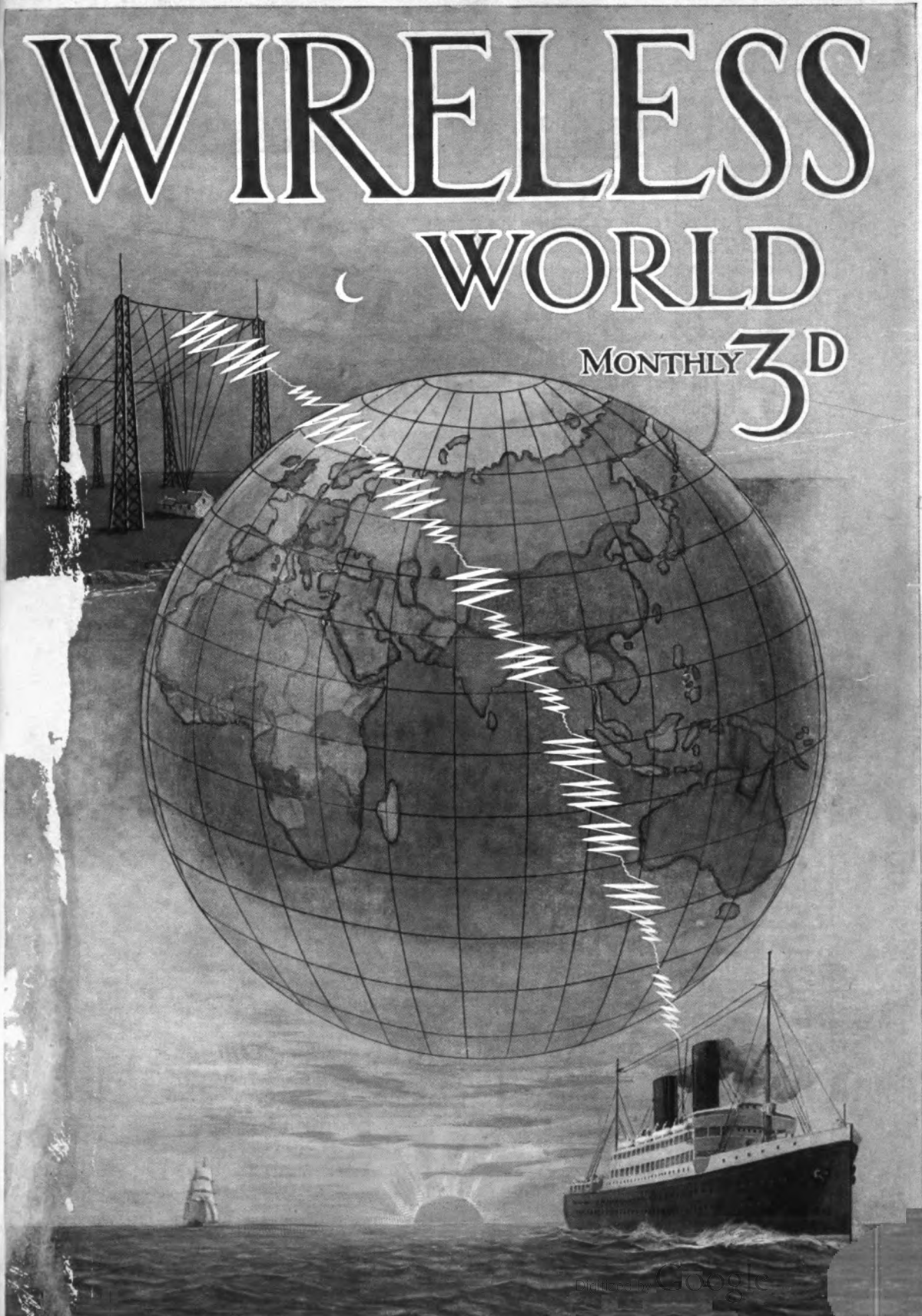
WIRELESS WORLD

MONTHLY 3D



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The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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Vol. 1.—No. 10. (New Series) January, 1914. Subscription 5/0 per annum post free. Price 3d. Post Free 5d

Wireless Telegraphy on Trains

THE experiments with wireless telegraphy on trains which have been conducted for some weeks on the Lackawanna Railroad received its first practical test on November 24th, and judging from the press accounts it is amply justifying itself already. The Lackawanna Limited, the only train in the world to carry wireless, was running at fifty miles an hour thirty miles east of Scranton, Pennsylvania, when a conductor of the train fell ill. In the ordinary way considerable delay would have been necessitated by a change of conductors, but in this case a wireless message was sent ahead to Scranton, and when the train arrived there an emergency man was waiting, and the disabled conductor was able to leave his post and consult a physician without delay. Wireless saved still another loss of time when word was sent ahead that the train was so crowded that another Pullman carriage was required. Mr. L. B. Foley, Superintendent of Telegraphs, who was on board the Limited, predicted that the day was not far distant when every train and railway system in the world would be equipped with wireless. "As a means of preventing accidents," said Mr. Foley, "I think wireless will prove of the greatest value. In the Underground at New York, for example, the train despatcher sits in his room, and by the flashing of lights knows exactly where every train is. If two trains get dangerously close together, he can send a signal that will almost instantly stop one or both of them. I believe that the same thing can be done on the railroads with wireless."

On the second day, November 25th, another distinct point was registered in the applications of wireless telegraphy when, for the first time on record, news bulletins taken by wireless were displayed on a moving train. The New York correspondent of the *Daily Telegraph* says that the results of the first day's practical test were so encouraging that officials made arrangements for a news service which is unique in history. Passengers on the train were astonished to see the latest foreign and home despatches spread before their eyes as they were being whirled along at sixty miles an hour. Messages from Scranton gave passengers the latest news of the Mexican situation, the stock market quotations, the White House wedding, etc. Several travellers sent messages to their friends telling the exact position of the train and the time of arrival at their destination. We have already published information relating to this interesting experiment which promises so much in regard to safety on railways, and in an early issue we hope to supplement this information with the results of the working of the system. The work was carried out by the American Marconi Company.

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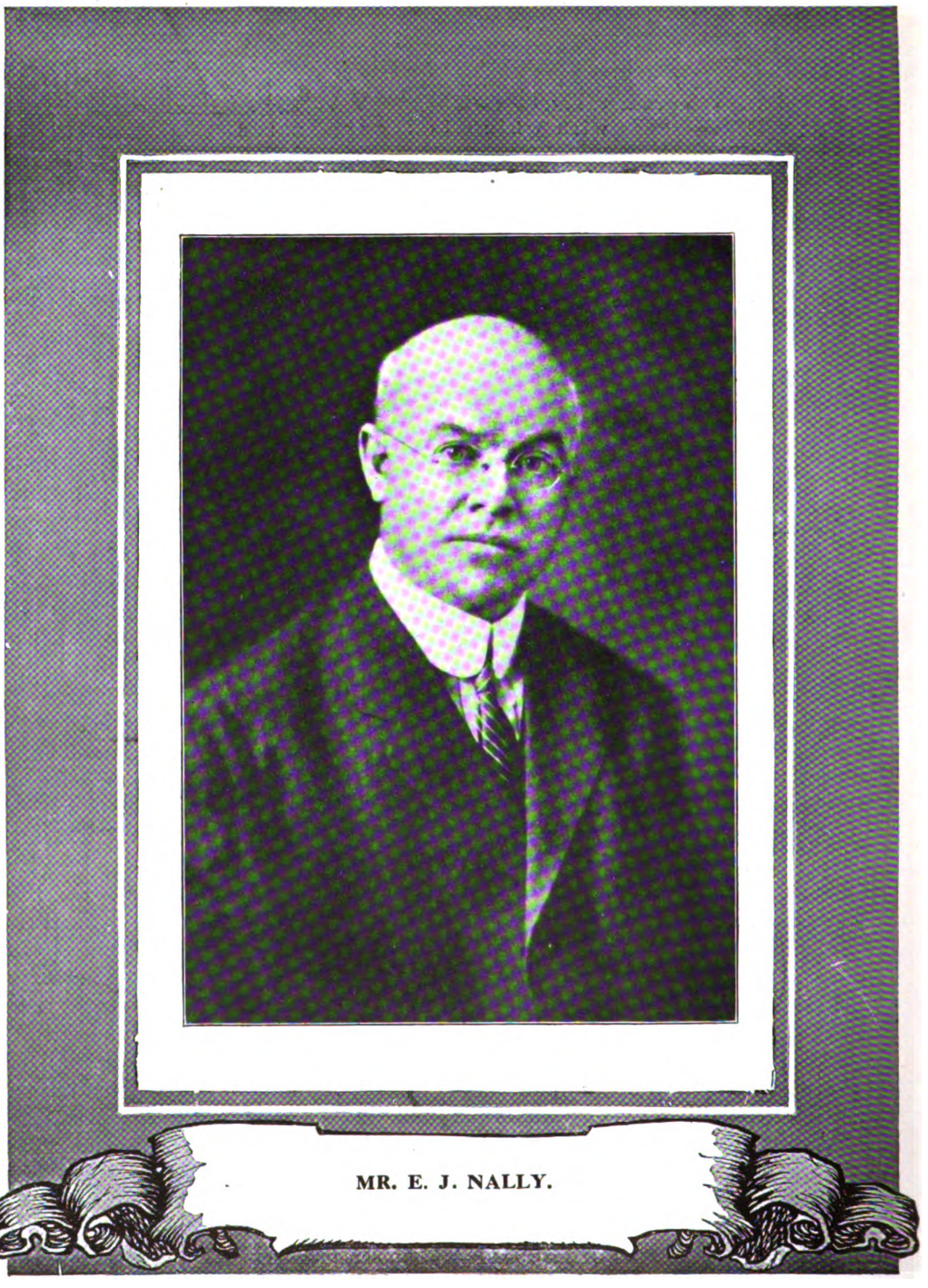

MR. E. J. NALLY.

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Personalities in the Wireless World

MR. EDWARD J. NALLY

Vice-President and General Manager of the Marconi Wireless Telegraph Company of America.

THERE are few more interesting personalities in the wireless world than Edward J. Nally, the recently appointed Vice-President and General Manager of the Marconi Wireless Telegraph Company of America, for his life is an unbroken record of splendid achievement and remarkable ability. Most of us learn by failure the lessons that promote success, but Mr. Nally is not of this category. A beneficent fate endowed him with all the talents, and though he started life without worldly advantages, he has steadily climbed step by step up " young ambition's ladder," and now has attained the topmost " round." Yet it can never be said that at any time has he spurned " the base degrees by which he did ascend," and it is his sympathy with all those in the subordinate positions which once he himself occupied that makes him one of the most loved of America's great business men.

Born in 1859 of Irish parents, the young Nally spent most of his boyhood in St. Louis. His father, who had emigrated from Ireland when still a young man, had prospered exceedingly, and for many years was a man of influence and position in his adopted city ; but while Mr. Nally was still a little boy, a succession of business reverses set in, and the family was brought to the verge of destitution, so that the early years of young Nally's life were absorbed in a struggle to make ends meet. Here the grit of the boy made itself apparent. No chances of turning " an honest penny " were ever missed, or work, even of the most arduous description, shirked. But the crowning misfortune was the failure of his father's eyesight when Nally was still only eight years old, and the boy was obliged, in order to keep the home together, to work as a cash boy in a departmental store for the magnificent wage of thirteen dollars a month. When he was sixteen he entered the Western Union Telegraph Service as a messenger boy. In 1878 he was given a junior clerkship, and later he held several higher positions in the Western Union.

But the time of the flood-tide in his career was approaching. A few years later he was offered an appointment with the Great North Western Telegraph Company, and became their superintendent at Minneapolis. In 1890 he became assistant general superintendent at Chicago. Within a year he was made general superintendent ; five years later, vice-president, director and member of the executive committee with headquarters in New York ; finally, on April 11th, 1904, his forty-eighth birthday, he became Vice-President and General Manager, which position he continued to hold until his retirement a few months ago. In transferring his interest to the Marconi Company, his object was to identify himself with a movement which he knew would have a permanent influence on the world's progress.

But enthusiastic man of affairs as he is, Mr. Nally has yet found time for other interests. In 1897 he married Miss Lee Warren Redd, of Lexington, Ky., and is the devoted father of a son and daughter. He has a beautiful home at Ossining-on-the-Hudson, the house commanding the splendid sweep of the river at this point, His greatest hobby is his library and collection of rare prints and etchings, over which he has spent many of his pleasantest hours ; for he acquired a rare taste in mezzotints and engravings while he was yet a boy, when night after night at the close of business he he used to visit an old book and print shop in Ninth Avenue, St. Louis, where the proprietor allowed him to rummage to his heart's content, and gave him full value for his few odd cents saved each day by walking to and from work.

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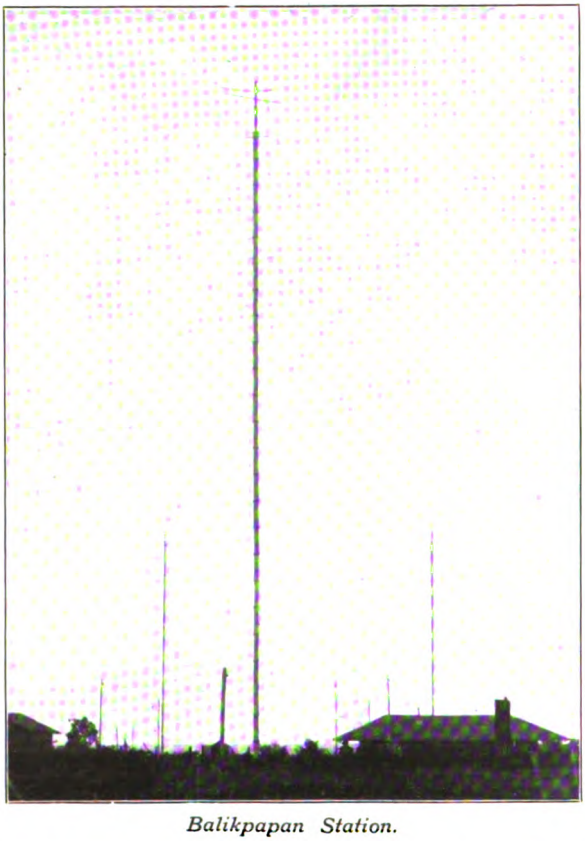
Wireless in Equatorial Borneo

By S. F. KOS.

BALIKPAPAN AND TARAKAN STATIONS. SUCCESSFUL EXAMPLE OF WORKING IN THE TROPICS. WHY THE STATIONS WERE REQUIRED. LIFE IN THE OILFIELDS.



Balikpapan Station.

THIS article deals with two modern Marconi wireless telegraph stations, one a medium-power and the other a high-power station, which have been erected at Tarakan and Balikpapan, in Dutch East Borneo. The stations were built for the Bataafsche Petroleum Company. This company obtained a licence from the Postmaster-General for the Dutch East Indies, and placed a contract for two suitable stations with the Marconi Company. In granting the licence the Government made the stipulation that the station at Balikpapan must be made capable of working with other stations at Sitoebondo, on the Isle of Java, and Timor, on the Isle of Koepang.

The station at Balikpapan is situated 116° 52′ E, 1° 15′ S., and the station at Tarakan is on a little island off the mainland, 117° 38′ E., 3° 20′ N.; the distance between the stations as the crow flies is 278 nautical miles (516 kilometres), and the intervening country is of a most unfavourable nature from a wireless point of view. This was not by any means the first time, however, that the Marconi Company had to contend with tropical conditions. Past experience stood in good stead for the design of these two stations, which have given full satisfaction from the moment they were put into operation.

At Tarakan, where no sufficient supply of electrical power was available at the time the stations were being erected, a 29 h.p. oil engine was installed as prime mover. This engine drives by belt an alternating current generator, with an output of 13 kilowatts normal, at a pressure of 1,000 volts, and a frequency of 200 periods. Mounted on the same shaft as the alternator are a small continuous current dynamo (which supplies current for the excitation of the alternator, a small blower motor, and a " signalling switch ") and the Marconi Rotary Disc Discharger. The current from the alternator is transformed up by a static transformer to a potential of 13,000 volts, and this high tension current is used to charge a condenser, consisting of 24

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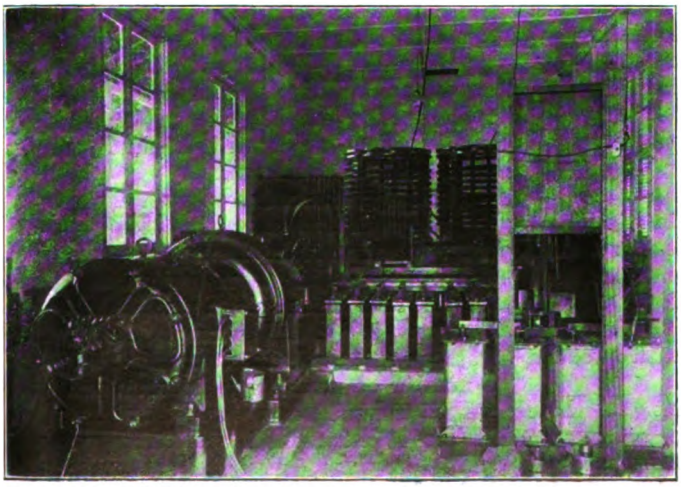
Standard Poldhu Units, in earthenware containers, connected 12 parallel and 2 series. The oscillatory discharge of this condenser takes place through the primary of the jigger, or oscillation transformer, and across a double spark gap at the rotary disc. The jigger is of the open type, providing air cooling and a maximum facility for varying the coupling between primary and secondary. The rotary discharger carries a number of studs which have a definite relation to the periodicity of the alternator, thus producing a spark frequency of 400 per second. A spark of this nature gives forth a good sounding musical note of just the right pitch for telephonic reception at the receiving station. "Higher" notes are sometimes employed, but it is doubtful whether they are as good for "continuous" work, as the human ear soon tires through listening to these notes for prolonged periods, often losing all sensitiveness for reception of weak signals. Another feature of this form of discharge is its quenching action: the spark takes place between two electrodes, which are fixed but for a rotary movement about their own axis (for cooling and equal wearing purposes) and the studs on the periphery of a rapidly rotating disc. The result is that the spark exists just long enough to give a powerful impulse to the primary oscillating circuit, and thus through the coupling of the jigger to the radiating aerial; but there is no time for the formation of an arc, the resistance of which would cause a big decrement in the amplitude of the waves and give rise to other harmful phenomena. The waves thus radiated are but feebly damped; they possess all the advantages of "continuous" waves produced, say, by an "arc" system of radiotelegraphy, without any of the disadvantages. For instance, their detection and reception does not necessitate the use of a "ticker" to split the waves up into groups of a frequency audible to the human ear.

Balikpapan—the Station Building.



The Transmitting Room at Balikpapan.

Signalling is effected by means of an ordinary operating key, such as is used in the Post Office; this makes and breaks a circuit which actuates a relay; this relay operates a lever carrying two contacts which make and break the 13,000-volt circuit. The arc which forms at these contacts on breaking is destroyed by means of a small electric blower. The aerial is of the semi-directional type and is suspended between three masts, one of 260 feet high and two of 150.

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Receiving Room at Tarakan.

The plant at Balikpapan is substantially the same as that at Tarakan, except that every part of the installation is larger in proportion to suit the higher power that is being dealt with at this station. The alternator has an output of 30 kilowatts normal at a pressure of 2,000 volts and 200 frequency. Electric power being available at Balikpapan, the alternator-disc combination is driven by a direct coupled electric motor, which receives current from a two-phase supply at a pressure of 2,000 volts per phase. On full alternator output this motor takes 42 kilowatts. The condenser battery at Balikpapan consists of 60 Poldhu units, connected 20 in parallel and 3 in series. The power normally used for communication between the two stations is only about 10 kilowatts (alternator output).

The aerial system at Balikpapan is also different from that at Tarakan on account of the extra requirements with regard to communication with Sitoebondo and Timor Koepang. It is of the multiple wire twin-T type, supported between five masts, one 260 feet high, and four 220 feet. All the masts at Balikpapan and Tarakan are sectional steel structures, with wooden topmasts.

Having described the plant at these wireless stations, and before passing to a summary of the actual performances of the stations, a little may now be said with regard to the demand for communication by wireless telegraphy in such an out-of-the-way part of the world. The most important settlement on the east coast of Borneo is Samarinda, and as a sort of "anti-climax" we may next mention Berouw and Boelongan. Coal is found in considerable quantities at Berouw, and for the rest the industry at all these three centres consists chiefly in the export of tobacco, sugar-cane, fruit, copra (*i.e.*, flesh of the coconut), etc.

But there are several other settlements along the coast where the sole industry is the boring for oil and kindred undertakings, distillation of petrol, the gaining of paraffin wax, candle manufacturing being amongst the principal. The industries here are practically controlled by the Bataafsche Petroleum Company, and nearly all the inhabitants are in the employ of the company. The head offices for the Indies of that company are at Batavia, whence the various undertakings throughout the Indies are controlled. But for Borneo only, the headquarters are at Balikpapan. Here are all the "works" necessary for cleansing and separating the products which are gained from the wells in the various districts, also numerous large tanks for storage.

The "white" population does not number more than about three hundred; but the male portion of this small community controls some thousands of Chinese, Javanese, Malays and Lascars.

Balikpapan is connected with Samarinda by telegraph line and by cable with the other islands of the Archipelago and the Continents. The town enjoys a good service of steamers from the Paketvaart Company and other transport lines. The Bataafsche Petroleum Company also own a number of small cargo steamers and two steam yachts. These vessels call at most of the settlements of the Company, but some of these, nevertheless, are quite isolated. This certainly applies to Tarakan,

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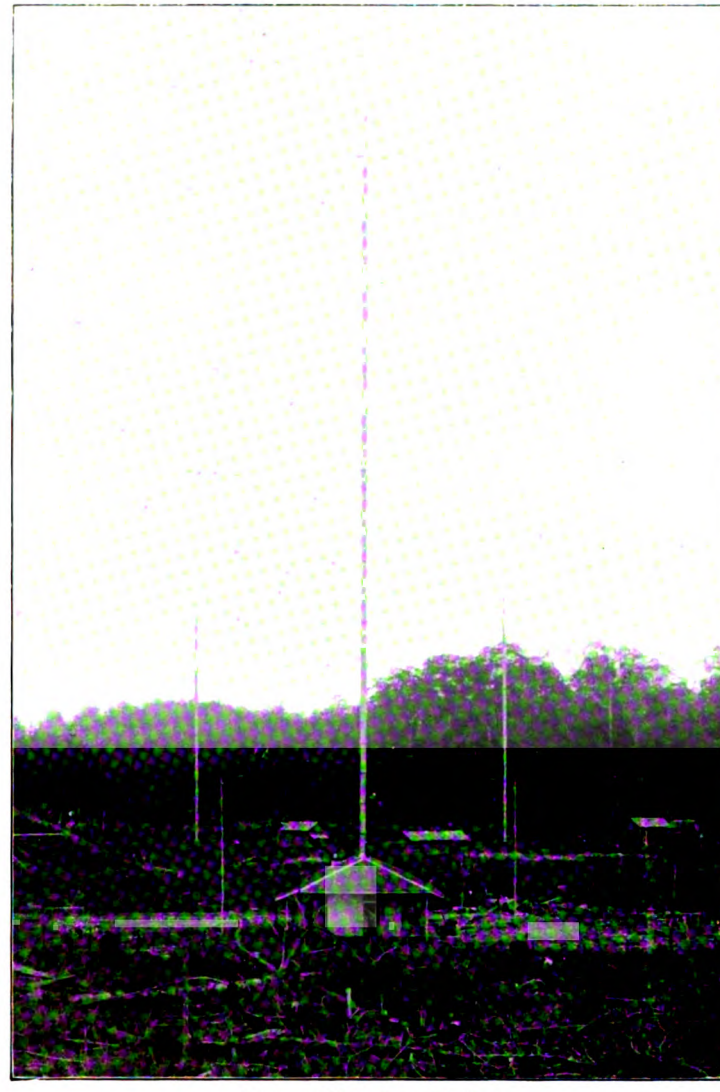
one of the most important centres of operation of the Company, where the Paketvaart Company's steamers call about once in three weeks.

Although Tarakan does not boast many "spouters," there are a great number of pumped wells, regularly producing an amazing quantity of crude oil, which is nowadays in so great demand for fuel for boiler furnaces and crude oil engines. This oil is mainly transported by tank steamers, which call first either at Balikpapan or at some other port in telegraphic communication with Balikpapan, so that the latter is always advised by telegraph of the prospective sailings and calls and requirements of these tank boats. The sailings and the amount of cargo required are never regular, so that formerly much time was wasted. But now that there is an efficient wireless communication between the two places, Tarakan is regularly advised of the callings of any steamers and the amount of cargo required by them. Balikpapan on the other hand, is kept informed as to the exact state of the production at any time, and can make arrangements accordingly. There are, of course, many other reasons why a prompt and rapid means of communication is here so very desirable, such as movements of the staff, provision of stores, machinery, workshop materials, etc.; but quite apart from any business considerations it must be a great relief for the handful of Europeans at Tarakan (there are only about twelve of them amongst hundreds of coolies) to know that they can communicate with Balikpapan to summon aid if there be need of it at any time.

But why was wireless chosen as the means of telegraphic communication? Principally on account of its reliability and facilities for upkeep, as well as for considerations of cost. If it were even possible, the laying of a cable from Tarakan to Samarinda would



View of Tarakan Station.

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have entailed enormous expense, and the upkeep would have been another big item.

The erection of the stations was completed within six months after the delivery of the plant. Balikpapan commenced working on February 1st, 1912, and during the fortnight following, tests were carried out with the station at Sitoebondo, which was completed almost simultaneously. These tests were quite satisfactory. About a month after Tarakan was also working, and April saw the stations in regular communication. The first few weeks were occupied in making tests for tuning, etc., messages for the Bataafsche Petroleum Company being exchanged, though not yet officially. From May 3rd until June 3rd an official service was carried on between the two stations by the Marconi Company for the Bataafsche Petroleum Company, to demonstrate the efficient working of the stations previous to their being taken over. This service was very satisfactory, numerous messages being exchanged, amounting to as many as 5,000 and 6,000 words per day, the official hours being from 9 a.m. till noon, and 3 p.m. till 6 p.m. Among the messages exchanged was some of the most difficult matter for any telegraphic concern to handle.

The stations were then taken over by the Bataafsche Petroleum Company. Two operators from the Marconi Company entered the service of the Bataafsche, and these gentlemen have since been operating the stations successfully. They are assisted in their work by native attendants only. Both the stations are under the control of Mr. A. G. Hendrikse, of the Petroleum Company, and in a recent communication he states that "the service continues to give every satisfaction."

Communication between Balikpapan and the stations at Sitoebondo and Timor Koepang, distances of, respectively 460 nautical miles (853 kilometres) and 672 nautical miles (1,247 kilometres), was easily established and maintained. Signals from Balikpapan are reported to have been heard at Sabang, about 3,000 kilometres distant, and in the Philippines.

Certain steamers of the Paketvaart Company are now also equipped with the Marconi System, and the "BPP" and "TAR" stations (these are the official call letters) have only recently been thrown open for public service with these steamers. For these communications, which must be effected on the regulation 300 and 600 metre waves, a subsidiary plant was installed at each station. The subsidiary plant, however, is excited from the main plant by means of a "cascade connection." This saves all the extra generating machinery which would otherwise be required, and has the advantage of giving the same musical note on the short waves as on the long ones, although a "fixed" discharger is employed for the short wave bank; the explanation is that the supply current from the big plant already has a frequency of 400.

"LIFE" IN THE OILFIELDS.

The man who is devoted to the attractions and amusements of a city life had better stay away from Borneo. Life here is essentially "home life" after strenuous business hours in a temperature of about 100 degrees in the shade! And the home is more often than not greatly lacking in comfort. Many of the workpeople live in "native houses"; a structure of stout branches, walled and roofed in with "katjang," *i.e.*, a kind of palm leaf, cured in the sun. Nevertheless this style of house, if built with some care, is habitable for a year or two. It certainly has the advantage of being cool. All dwelling-houses are built on piles averaging about six feet in height. This is necessary to keep snakes, centipedes, and numerous insects out of the house. And even with this precaution many undesirable "aliens" still find their way in. For instance, one night I found a centipede on the inside of the mosquito net, many of these are 12 inches and even longer. When they run along the "katjang" walls they are readily detected, as they make a peculiar noise, due to the hard scales of their bodies rubbing against the dry palm leaves. To find one of these in bed is not altogether a happy experience, for a bite causes severe illness which often ends fatally. Snakes entered the station building on one or two occasions, and once, when kneeling on the floor drilling a slate panel, I heard a rustling behind me, and, on looking round, found it was caused, not by silk skirts, but by a snake, about five or six feet long. I believe

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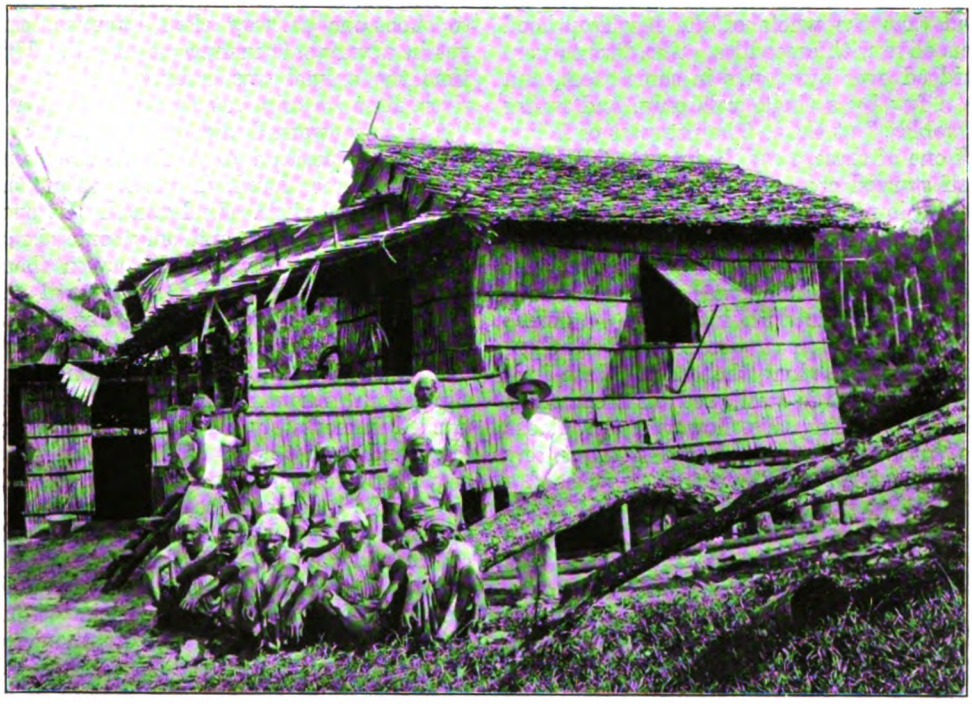
I howled, which was foolish, as I was quite alone in the building, the incident occurring in the "tiffin" hour; I certainly jumped, which was sensible. I played hide-and-seek with that snake for the next twenty minutes or so, but finally got him. On another occasion the Petroleum Company's engineer, Mr. Hendrikse, "collected" a couple of snakes from under the roof, where they were hidden in the wooden box built round the aerial leading-in insulator.

The Marconi stations, both at Balikpapan and Tarakan, are some distance away from the European settlement, at Balikpapan the distance being five kilometres. Some thousands of trees were cut down, both to clear the sites for the stations themselves and also to make a big open space "at the back" of them, to avoid, as far as possible, any screening effect. This sounds a fairly big job in itself; but the Malay coolies, though addicted to laziness, if given the chance, are nothing if not cunning. So they would tackle one of the most formidable looking forest giants with axe and saw and fire, and when the tall and heavy one finally succumbed to their combined efforts it would bring down several of the surrounding lighter trees in its fall. Thus the station is situated in a big, open space, bordered by thick jungle on the one side, and the sea of Celebes on the other. At Tarakan there is nothing but jungle all round. A pipe line for oil transport runs past the station into the forest and is laid through it along the crest of a hill; it ends at Lingkas, the "port" of Tarakan "Port" here means a few bungalows, numbers of large oiltanks, and a wooden jetty built some way into the sea. My colleague, Mr. Jones, will remember how he taxed my nerves severely on one occasion. On a Sunday afternoon we walked to Lingkas along the pipe line through the forest. At Lingkas we paid a visit to the only European who was there at the time, drank some clappa-ajer—*i.e.*, coconut milk, and talked until it was quite dark. We did not quite like the walk back through the forest, but my friend Jones informed me



Mr. F. Post, and his gang of Lascar labourers engaged in Mast Erection.

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that there was a newly-made road which would lead us safely home. Fortunately we secured a little oil lamp, for the night was pitch dark. The first part of the journey was quite easy, except that we had to go up and down hill and scale fallen trees, which were 6 feet and more in diameter. This, by the light of an oil lamp, requires a certain amount of skill. But the exciting part came when we reached level ground. The road, indeed, *was* newly made! It seemed to run through a marsh, and every hundred yards or so it was cut across by ditches. Jones informed me that all these ran into the river, which flowed near by, and that the whole of the neighbourhood was alive with crocodiles. The ditches were bridged over by planks in some cases, and in a few by a single pole only, and rather "wobbly" at that. The prospect of falling off one of these, possibly into the jaws of a half starved crocodile lurking in the darkness below, did not make me feel very comfortable. The journey ended, however, without mishap. I thought at the time that Jones, my companion, was playing a practical joke on me with his story, but since then I have often seen crocodiles both there and elsewhere along the coast. Once in a while a native is swallowed by a crocodile. Notwithstanding this, however, the blacks go into the river to bathe without any apparent fear. At Samarinda I watched a number of native children plunge into the river together, shouting loudly "boewaja" (crocodile) all the time. At first I used to take my morning dip in the sea at Balikpapan, but the unwelcome appearance of a crocodile made my visits few and far between. I had not known of crocodiles entering the sea; but apparently they do so to fish. They stay in for hours at a time, and one Sunday morning we spent an exciting time in hunting one. On this occasion the crocodile was at the mouth of the river, which flows into the sea not far from the Marconi station; it had to wait till the tide was at its highest to be able to cross the bar. When we got to the spot it was just getting out, bellowing like a cow all the time. We fired one or two shots at it from a sporting rifle, but they took no effect, for the crocodile swam well out from the shore and then along it, travelling about three miles an hour. We hunted our elusive friend for two or three hours, firing at times, but without effect (the hard scale on the body resists a rifle bullet unless fired at very short distance); but finally it began to come closer in to the shore; we waded waist-high into the water and a well-directed shot probably hit the brute right in the eye. It threw up its head and apparently was flung right over backwards; then it sank and did not come up again. We waited about for an hour or more but did not see it again; nor was it washed up afterwards—at least, not to my knowledge.

On another occasion I was lucky enough to shoot one at very close quarters, and yet in a very safe manner to myself. This time the animal was coming back to the river after its trip out to sea. As usual, the natives warned me of its advent; I took up a position on a footbridge some two or three hundred yards from the mouth of the river. Underneath this spot the water was clear, and only some six or eight feet deep. Mr. Crocodile swam about outside the bar for some time, until the tide was at its highest. All the time he was loudly booed by scores of natives who had collected to watch the fun. Finally he slipped in through the gully and then ducked immediately. I waited for ever so long, and at last spotted him just in time, crawling over the sandy bottom of the river. His head was already underneath it, so I jumped round quickly to the other side of the bridge and then fired at him straight down. He made a great commotion and turned right round on his back. Mine was not a repeating rifle, so he managed to escape; but I followed him along the river, reloading speedily. A minute or so after he had to come up to breathe, and then I hit him in the head again, the distance being only some thirty or forty yards. But I did not get this victim either, as he sank on the off side in the river, which flows into a marshy part of the jungle.

Life in such countries is, of course, full of exciting and amusing incidents, but space does not allow me to relate many of them. I may, perhaps, mention one amusing anecdote. The Malays are passionate gamblers. On pay days it is the custom to give them their money before noon, and after that no more work is done for the

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rest of the day. Immediately they have their money they all squat down in groups, a cloth marked in black and white squares and figures is spread on the ground, and the "banker" produces a "dado"—a spinning top with six sides, marked with figures corresponding to those on the cloth. The dado is spun and a basin placed over it; the players put their money on the various squares and the banker doubles each amount from his own pocket. After sufficient time has been allowed for the dado to come to rest, the basin covering it is lifted; the dado lies with one of its sides up, and the figure showing is the winning one.

In the Chinese "kampong" (village), there is quite a little Monte Carlo, called in Malay the "Roemah Majin"; this is run by Chinamen and patronised chiefly by Malays.

One Sunday I gave one of my coolies a Ryksdaalder—*i.e.*, a Dutch coin equivalent to about four shillings, and instructed him to go into the kampong and purchase a duck for my dinner. He left about midday and could have been back within an hour. But one o'clock came, and two, and then three and four, and through another couple of weary hours I impatiently watched for the return of my toekang ajer (water carrier); this was his special duty when not fetching ducks). I also sent another boy in quest of him. At six o'clock he returned, fell on his knees, buried his face in his hands, and touched the ground with his forehead, as a sign of entire submission. But I had no duck for dinner that day, and some Chinamen in the Roemah Majin were the richer by four and twopence at my expense. Toekang Ajer next day lost his easy job of carrying water for bathing and drinking purposes from the forest, and had to do some wholesome digging in the earth trenches instead for days after, to cure him of his gambling habits. But next pay day he lost his "gadji" (wages) to the dado god as lustily as ever.

A Native Village near Tarakan.

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An Atlantic Sentinel.

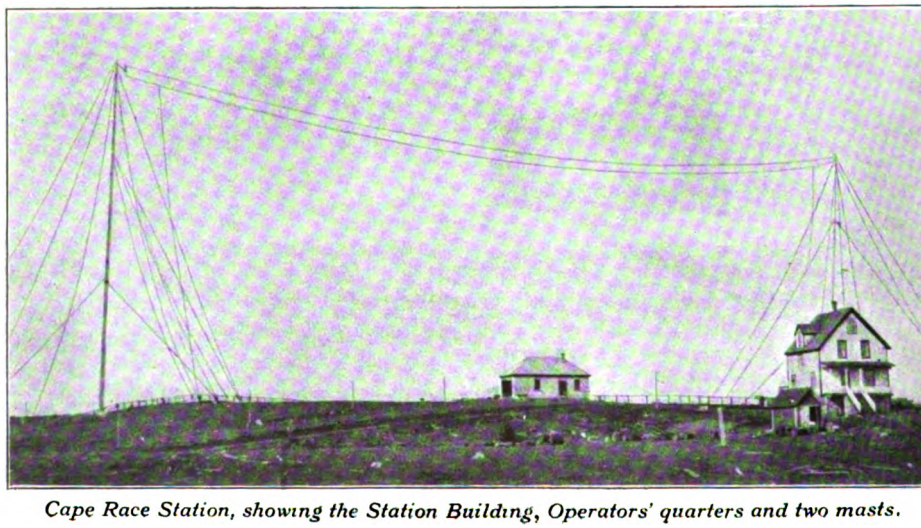
THE NEW STATION AT CAPE RACE.

WITH the completion of the new wireless station at Cape Race a fresh series of successes in wireless telegraphy has been recorded from the Canadian Atlantic system.

The first station was built in 1911, and had a range of 300 miles. It was destroyed by fire in May, 1913, but the Canadian Marconi Company lost no time in proceeding to equip the new station with the most modern apparatus, thus giving it greatly increased range. On October 11th, 1913, the new station was in operation.

Cape Race projects far into the Atlantic and is situated some 1,000 miles from Montreal and New York. As the new station possesses a normal range of 500 miles it is now possible to transmit Marconigrams from, say, Montreal or New York, *via* Cape Race, to vessels steaming in mid-Atlantic; not only to those on the Northern or Canadian route, but also to liners steaming on the Southern route and destined for the American ports. The sphere of operations of Cape Race station now covers a greater portion of the Trans-Atlantic steamship route than any other station on the American continent engaged in ship and shore business, and not only affords thereby new commercial advantages, but it will prove to be a special factor as an aid to vessels in danger which would otherwise have been beyond the range of land stations.

Notwithstanding the short period during which the new station has been in operation, remarkable figures have already been recorded. The Austro-American liner *Oceania* when on her westward voyage, early in November, was signalled at a distance of 750 miles east of Cape Race, the message constituting a record for a wireless signal from a vessel using the St. Lawrence route. That record, however, was speedily eclipsed, for on Monday, November 17th, a message was received from the C.P.R. liner *Empress of Britain* which was sent when the vessel was but half way across the Atlantic and while she was still nearly 1,700 miles east of Quebec, her exact position at the time being 834 miles east of Cape Race. These results were attained by night, but it can be expected with a fair degree of certainty that the station's guaranteed normal range of 500 miles by day will be considerably



Cape Race Station, showing the Station Building, Operators' quarters and two masts.

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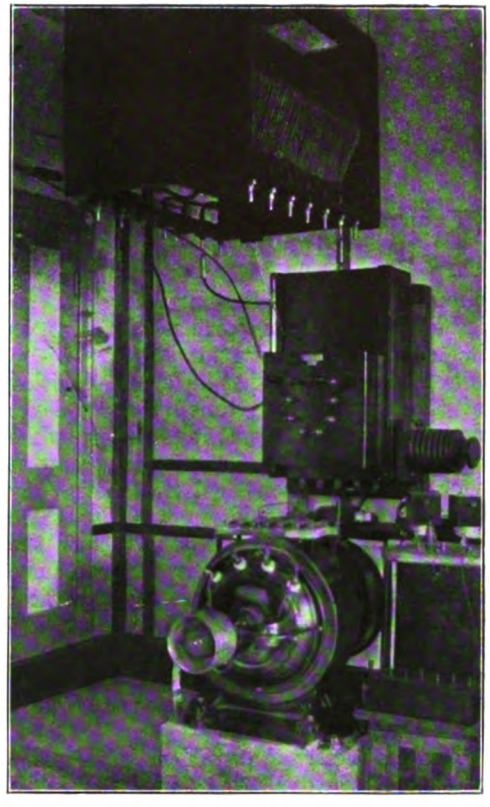
exceeded when the apparatus has been running a greater length of time.

The almost inestimable value of the Cape Race station as an aid to navigation in the Atlantic has been fully appreciated, and the station building and equipment has accordingly been designed to give the greatest possible security against interruption of service, the building being of concrete and the operating plant being duplicated throughout.

The apparatus comprises two complete transmitting sets, each consisting of 5½ kw. generator, belt driven by 10 h.p. horizontal gasoline engine. Alternating current at 240 cycles and 440 volts single phase is generated. The transmitter is of the synchronous disc discharger type, giving a pure musical note of the frequency of 480 per second.

The transmitters are designed for wave-lengths of 300–600 and 1,800 metres, and intermediate lengths can also be obtained. Up to the present only the normal 300–600 metre waves for coast station service have been used, but it is quite possible that in the near future arrangements may be made to utilise the 1,800 metre wave for a long distance service with steamers transmitting a news service and general public correspondence. Signals on this wave-length should be readable on the one side by stations within range of Crookhaven or the Azores and on the other side by United States stations on Long Island.

The power plant, with generators and transmitters, is situated in one large room separated from the office and receiving room by a concrete partition. The receivers are of the latest design and equipped with the most sensitive detectors. A magnetic detector is also installed as an emergency receiver.



Transmitting Apparatus.

Instrument Room showing Switchboard, etc.

There was recently inaugurated at Madrid, in the presence of leading officers of the Telegraph Corps, an important school for the training of wireless telegraph operators. The ceremony was attended by the Director-General of Posts and Telegraphs, Mr. Arminan, who also represented the Minister of the Interior, who was prevented from attending by indisposition. Speeches were delivered by Mr. Lopez Cruz and by Mr. Arminan. Afterwards the various classes were visited and demonstrations of wireless telegraphy were witnessed. The school is situated at 23, Calle Echegaray, in the old Moctezuma Palace.

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Short Circuited Inductances.

By Dr. LOUIS COHEN.

IN a recent discussion at a meeting of the Institute of Radio Engineers a question arose regarding the effect of short-circuiting the overhanging turns of an inductance coil in an oscillating circuit, as indicated in the illustration below.

Some maintained that the short-circuiting of the overhanging turns produces large damping in the oscillating circuit, while others declared that their experience with such an arrangement had not shown any bad effects. It would appear that there exists some misunderstanding about the problem, and it will perhaps be of some interest to indicate briefly the mathematical solution of the problem, and to show that both views may be justifiable. It is all a question of the relative magnitudes of L_1 and L_2 and the mutual inductance between the coils L_1 and L_2.

Mathematically the problem is the same as that of the oscillation transformer. To simplify the discussion, assume a sine emf (undamped) acting on the oscillating circuit; we have then the well-known transformer differential equations for the two circuits, which are as follows:

$$\left.\begin{aligned} L_1\frac{dI_1}{dt}+R_1I_1+\frac{1}{C_1}\int I_1dt+M\frac{dI_2}{dt}=Ee^{i\omega t} \\ L_2\frac{dI_2}{dt}+R_2I_2+M\frac{dI_1}{dt}=0 \end{aligned}\right\} \quad (1)$$

Solving these two equations, we get for the absolute values of the currents in the two circuits:

$$I_1=\frac{E\sqrt{L_2^2\omega^2+R_2^2}}{\sqrt{\left((M^2-L_1L_2)\omega^2+\frac{L_2}{C_1}+R_1R_2\right)^2+\omega^2\left(L_2R_1+L_1R_2-\frac{R_2}{C_1\omega^2}\right)^2}}$$

$$I_2=\frac{EM\omega}{\sqrt{\left((M^2-L_1L_2)\omega^2+\frac{L_2}{C_1}+R_1R_2\right)^2+\omega^2\left(L_2R_1+L_1R_2-\frac{R_2}{C_1\omega^2}\right)^2}} \quad (2)$$

The circuit may be tuned in two ways: it can be tuned without any regard to the secondary circuit, or the system as a whole can be tuned including the secondary circuit.

In the first case $L_1\omega-\frac{1}{C_1\omega}=0$, and the expression for I_1 in equations (2) reduces to

$$I_1=\frac{E\sqrt{L_2^2\omega^2+R_2^2}}{\sqrt{(R_1R_2+M^2\omega^2)^2+R_1^2L_2^2\omega^2}} \quad (3)$$

In the second case, tuning the system as a whole,

$$(M^2-L_1L_2)\omega^2+\frac{L_2}{C_1}=0$$

or

$$\omega^2=\frac{1}{L_1C_1(1-K^2)},\quad \left(K^2=\frac{M^2}{L_1L_2}\right) \quad (4)$$

and the expression for I_1 in equation (2) (neglecting R_1R_2) becomes

$$I_1=\frac{E\sqrt{L_2^2\omega^2+R_2^2}}{\left(L_2R_1+L_1R_2-\frac{R_2}{C_1\omega_2}\right)}=\frac{E\sqrt{L_2^2\omega^2+R_2^2}}{\omega(R_1L_2+R_2L_1K^2)} \quad (5)$$

If the overhanging coil were entirely removed and the oscillating circuit tuned to its natural period, we would have

$$I_1'=\frac{E}{R_1} \quad (6)$$

Comparing equations (3), (5) and (6), it is seen that by tuning the primary circuit alone, the presence of the short-circuited overhanging coil (or closed secondary) reduces the current in the primary circuit in the ratio,

$$y_1=\frac{I_1}{I_1'}=\sqrt{\frac{R_1^2}{R_1^2+\frac{2R_1R_2M^2\omega^2+M^4\omega^4}{L_2^2\omega^2+R_2^2}}} \quad (7)$$

Tuning the system as a whole, the effect of the closed secondary is to reduce the current in the primary in the ratio,

$$y_2=\frac{I_1}{\quad}=\frac{R_1\sqrt{L_2^2\omega^2+R_2^2}}{\omega(R_1L_2+R_2L_1K^2)} \quad (8)$$

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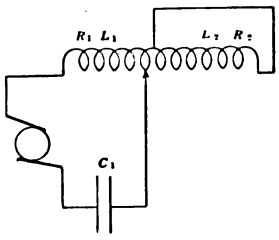
An examination of equations (7) and (8) will show what effect the closed secondary may have under different conditions. If the overhanging coil consists of a large number of turns, so that L_2 is large compared with L_1 and M_1, the effect will be negligible and either by (7) or (8) $y = 1$ approximately.



Short-circuiting the overhanging turns of an inductance coil in an oscillating circuit.

The greater the value of L_2 the closer the approximation If, on the other hand, the overhanging coil consists of only a few turns, so that L_2 is small compared with L_1 or M_1, the effect may be very serious, and in some extreme cases the current in the oscillating circuit may be reduced to almost zero because of the closed secondary.

One or two illustrations will perhaps make it clearer.

Assume the case of a coil of 100 turns, length 10 cm., radius 5 cm., with ninety turns overhanging.

$L_1=0{\cdot}02$ mh., $L_2=0{\cdot}59$ mh., $M=0{\cdot}024$ mh.

Assume $R_1=10$ ohms (including radiation resistance of antenna, if the coil is part of an antenna circuit).

$R_2=3$ ohms, $\omega=10^6$.

For these constants we have by (7),

$$y_1=\frac{10}{\sqrt{100+\frac{34,560+332,000}{348,000}}}=\frac{10}{\sqrt{101}}$$

$=1$ approximately

By (8)

$$y_2=\frac{10\times 590}{10\times 590+3}=1 \text{ approximately.}$$

Short-circuiting the secondary has practically no effect on the current in the primary in this case. Suppose, however, that only thirty turns are overhanging. Then,

$L_1=0{\cdot}42$ mh., $L_2=0{\cdot}12$ mh., $M=0{\cdot}056$ mh.

Assume $R_1=10$ ohms, $R_2=1$ ohm, $\omega=10^6$.

For these constants, by (7),

$$y_1=\frac{10}{\sqrt{100+\frac{11,090,000}{14,400}}}=\frac{10}{\sqrt{100+770}}=0{\cdot}34.$$

The current in the primary circuit is reduced to 34 per cent. of the value that it would have if the secondary circuit were entirely absent.

If the system is tuned as a whole, including the secondary, we have by (8)

$$y_2=\frac{10\times 120}{1,200+26{\cdot}4}=0{\cdot}98.$$

For this case, tuning the system as a whole, the current in the primary will not be affected materially by the presence of the secondary.

Consider now an extreme case, the overhanging coil consisting of a single turn.

$L_1=0{\cdot}68$ mh., $L_2=0{\cdot}0003$ mh., $M=0{\cdot}006$ mh.

Assume $R_1=10$ ohms, $R_2=0{\cdot}05$ ohms, $\omega=10^6$.

By (7) $y_1=0{\cdot}09$.

By (8) $y_2=0{\cdot}33$.

For this case even by tuning the system as a whole the current in the oscillating circuit is reduced to one-third its normal value.

It is evident, therefore, that the effect produced by short-circuiting the overhanging coil depends altogether on the relative magnitudes of L_1, L_2 and M.

Experiments made some three years ago by the writer gave results which were in general in agreement with the above. It was suggested at that time that a single-turn secondary placed within the inductance coil so as to get the maximum mutual inductance and rotating it back and forth through 90 deg. would produce sufficient variation in current to serve as a means for sending signals in a wireless station in place of the key generally employed.

[The question whether efficient tuning can be carried out on an inductance by the method of short-circuiting a variable amount of it is one which, in one form or another, is continually presenting itself to amateurs. The mathematical view of the problem is treated by Dr. Louis Cohen with his usual distinction in the above paper reprinted from the "Electrical World" of New York. The investigation shows that under certain conditions the method may result in very serious loss.—*Editor.*]

Flinders Island has now been brought into touch with the Australian wireless system by the establishment of a station there.

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The Characteristics of Insulation Resistance

IN a paper recently read before the Institution of Electrical Engineers, Mr. Evershed dealt with this subject which is of interest to every wireless engineer.

During recent years a great deal of valuable research work has been done to increase our knowledge of the properties of insulating materials, yet, notwithstanding the progress so made, the natural laws governing insulation resistance are but little understood. So little that if at the outset of this paper a plausible statement were made to the effect that the insulation resistance of an electrical system depended mainly upon the dielectric properties of the insulating materials, it might easily pass unchallenged. Possibly some objectors might be found among those who have to maintain the insulation of electrical plant; for no one who has had much experience of the behaviour of insulation in practice could fail to be struck by the disparity between insulating materials under test in the laboratory and the same materials under the ordinary conditions of use. It is, of course, easy to guess that the disparity is generally due to the presence of moisture; and, in fact, the only insulating materials whose behaviour in use corresponds with their predetermined dielectric properties are those which are non-absorbent. Of the remainder, and they form the majority of the materials in common use, we can only predict that the insulation resistance of any electrical system in which they are used will be governed almost entirely by the moisture they absorb. Everyone knows that insulation resistance decreases on a damp day and recovers during dry weather. It is, perhaps, not so generally known that in most cases insulation resistance decreases, in a perfectly definite way and almost instantaneously, as the electric pressure upon it is increased, and slowly recovers if the pressure is restored to the initial value or cut off altogether. The connection between these two facts is by no means obvious, yet they are so closely related that if we succeed in explaining one of them we shall certainly understand the other. The effect of moisture, the effect of voltage, the effect of polarity, these and other phenomena commonly met with in insulation have been forced upon the author's attention for many years past, and the pressing need to find answers to the questions that so frequently arise in connection with insulating materials induced him to undertake an experimental research with a view to the better understanding of their behaviour in everyday use.

What is the margin between the working voltage and breakdown? That is the fundamental question at the root of every inquiry into the properties of insulation. If a definite answer is ever forthcoming, it will not have been found in "blind" tests of breakdown voltage. To conduct tests without any means for ascertaining what is going on in the insulator as the breakdown voltage is approached, without either observing the current or, better still, the resistance, is to shut our eyes and deliberately avoid looking for the cause of failure. (The flash test as applied to some costly piece of electrical apparatus must have been inspired originally by something akin to the heroism of the savage.) The author has therefore sought, by investigating the nature or leakage conduction, to establish some definite relation between applied P.D. and insulation resistance. If the curve expressing this relation be traced from a few volts up to the breakdown point it will be found to consist in general of two parts of opposite curvature. The two parts of the curve will be joined together by an approximately straight line, the length of which varies greatly according to the nature and condition of the insulation. This connecting link is sometimes so short that the two parts of the curve appear to meet at a point of inflection, and they then form a sort of ogee curve. The research had not proceeded very far before it was realised that the shape of the first part of this characteristic curve is determined by the extent to which leakage is due to moisture, and, further, that leakage through the substance of the insulator—dielectric leakage—was negligibly

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small compared with that caused by the merest trace of moisture. This leads to the point of view that for most practical purposes an insulator may be regarded as having no inherent conductivity, the conducting power which it appears to possess being usually caused by leakage over damp surfaces. If the insulator is porous, then the leakage surfaces are not only those outside the insulating body, but those surfaces which bound the maze of capillary channels inside the porous material.

After dealing with moisture-curves of cotton and paper, Mr. Evershed said: "The degree of moisture in an absorbent material like paper may be varied within wide limits without much affecting the law of the moisture curve, although the corresponding variations in the resistance will be enormous. But when the material contains a considerable excess of moisture, so that it is sensibly damp, the law begins to change. . . . When an absorbent insulator is sodden with water its resistance follows Ohm's law."

Summing up the results of his researches with absorbent insulators, he said: "The composition of the insulating substance seems to be of little importance. So long as the structure of the material is such as to provide capillary spaces to harbour moisture leakage will take place in the characteristic manner. Of course, the difficulty of maintaining adequate resistance in absorbent insulators is fully realised, and they are seldom used without an attempt being made to exclude moisture by means of some non-absorbent insulator applied as an oil or a varnish, and intended to close all the capillary channels."

Mr. Evershed then went on to deal with the effect of filling up the pores of absorbent materials, taking as examples oiled paper and varnished windings, and showed that these attempts to get over the difficulty are by no means completely successful. "The experiments on oiled paper lead irresistibly to the conclusion that the mode in which absorbed water forms conducting paths is substantially the same whether the insulator is saturated with oil or not. The water may be in the insulator before impregnation with oil or it may be very slowly absorbed afterwards, but once inside it will conduct electricity just as though the oil was not there." With regard to the varnishing method he said: "It need hardly be pointed out that when a porous body is saturated with a liquid varnish, and the solvent is then dried out, the solid body of the varnish remaining in the insulator is necessarily insufficient in quantity to fill the pores. They can only be entirely filled up by soaking the insulator in oil, or in a melted wax, or in some equivalent solid insulator which can be liquefied by heat. Hence a porous insulator, even when varnished, is likely to have many channels available for the reception of water. Whether water can find its way into them depends on how far the varnish has been able to stop up the pores on the outside of the insulator." If the windings are subjected to the temperature variations which occur in ordinary use, varnish appears to be powerless to stop absorption altogether.

An interesting point dealt with in the paper was the "valve" effect of certain insulators; of which porcelain is an example; this effect leading to the phenomenon that the insulation resistance may be found to be very much greater when the voltage is applied in one direction than when it is applied in the other. This result Mr. Evershed explains by the theory of electric endosmosis, which he puts forward as the broad principle of all film-conduction in absorbent insulators.

THE PHYSICAL SOCIETY.

The annual exhibition of the Physical Society was held in London on December 16th, about forty firms contributing instruments to the exhibition, and these in many cases were shown in operation. The advances being made in the field of wireless telegraphy are invariably reflected at this exhibition. In the crystal receiver shown by the Marconi Company, the detector consists of two carborundum crystals, which can be used either independently or put in opposition. The direction finder is intended to be employed with a directive aerial system, and it is designed either for directive receiving or for ascertaining the direction of a wireless station. An adjustable air condenser was also shown at the Marconi stand. This instrument has been designed to give the largest possible capacity in a given space, whilst leaving sufficient gap between the plates to allow a pressure of 500 volts to be safely used with it. The maximum capacity is 0.01 mfd.

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Grounding System for High-Power Stations

ONE of the essential features of long-distance wireless stations is an effective grounding system.

In selecting the sites for the erection of the new Atlantic coast stations of the American Marconi Company, a number of elements had to be considered. The transmitting and receiving sites had to be more than twenty miles apart and correlated in such a manner that a line connecting them would be at right angles to the direction of desired transmission. The sites had to be chosen on low, marshy land on the coast, or near some waterway that would afford a direct electrical connection with the ocean. Where it was not possible to get the whole property in a marshy district it was necessary to have the land around the power-house at least damp and moist. Then, by burying a network of copper wires and zinc ground plates, a good electrical earth connection was possible.

With the middle of the oscillating circuit as a centre, wires radiate to a circle of zinc plates at a radius of 100 feet. This circle is continuous, all the plates being bolted together, and buried vertically in a trench, so that the radiating wires can be led down to the ground and soldered to the upper edge of the zinc ring. From the centre of the system about 224 copper cables, made up of stranded copper wire, are led from two sides of the building through insulators to the top of eight poles, set on a circle of eighty feet radius. From the insulators, on the top of these poles, the cables are separated and led down to the earth and soldered to points along the circle of zinc plates. The location of the eight poles and the separation of the cables is so arranged that the length of each cable from the centre of the system to the point it enters the ground is approximately the same.

Radiating from the ring of zinc plates there are about 112 copper cables soldered to the ring at equal distances. Each of these cables extends about 300 feet beyond the zinc ring and terminates in a zinc plate thirty inches by eighty-four inches, buried vertically. From these outer plates, on the side of the circle under the aerial wires, extends a further grounding system parallel to the aerial and extending under its full length and a little beyond. Local conditions however, usually make it necessary to slightly alter this general arrangement. Thus, the site of the power station at New Brunswick, N.J. (referred to in THE WIRELESS WORLD for November last), is situated in a swampy meadow and bounded by the Delaware and Raritan canal on the north-east side. Running beside the canal is a stream connected to the Raritan River by culverts under the canal. In view of this condition, it was deemed advantageous at this station to straighten out one side of the circle of zinc plates and bury a large number of plates in the bed of the stream, by this means assuring a good electrical connection through the Raritan River with the ocean.

At the receiving stations the circle of ground plates is made with a fifty-foot radius, with the receiving room of the operating house as the centre. The only wires extending beyond the circle of zinc plates are a number of cables radiating from the centre and extending in a marsh, or waterway, near which the operating house is situated. Each of these lines terminates in a zinc plate, as at the transmitting site.

A precaution, which is essential in the construction of the power-house and the running of power and lighting circuits, is to run all lines in iron conduit and thoroughly ground the conduit at frequent intervals; otherwise considerable difficulty might be caused by the current induced from the high-frequency oscillating circuits. Wherever possible, all circuits are carried underground, and the supply is run in conduit underground for about half a mile, approaching the power plant in a direction at right angles to the direction of the aerials.

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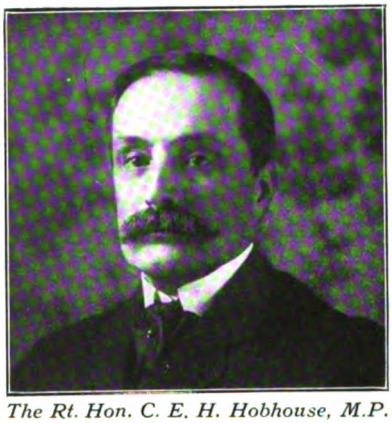
Radio-Telegraphic Research.

WE announced last month the appointment by the Postmaster-General of a committee to consider how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with ordinary telegraphy and telephony. The British Association, readers will remember, have also appointed a committee for the purpose of furthering radio-telegraphic investigations and it is interesting to note that during the past month, the Council of the British Association has made a grant of £500 to that committee out of a gift of £10,000 made to the Association for scientific purposes by Sir J. K. Caird at the Dundee meeting in 1912. The work which lies before both committees is to some extent identical, and useful results should accrue from the investigation of such mysteries of wireless telegraphy as are met with by observers distributed over a wide area.



The Rt. Hon. C. E. H. Hobhouse, M.P. Chairman of the Committee appointed by the Postmaster-General to consider the organisation of State Research in Wireless Telegraphy.

It should be clearly understood that the State Committee, which includes representatives not only of pure research work but of the Post Office, the Admiralty, the Army, and the administrative departments, is only an advisory body, and is intended to initiate, and not to carry out, research work. But a probable outcome of its work is the establishment of a special research department for wireless telegraph research at the National Physical Laboratory, and the presence of Dr. Glazebrook, the Director of the Laboratory, on the committee lends support to this view.

It is common knowledge that there are fundamental problems in wireless telegraphy which still await solution; neither the nature of the electro-magnetic waves employed in radio-telegraphy nor the mode of their propagation has yet been definitely determined. There is no dearth of hypotheses, but none of the theories yet advanced can be held to explain all the observed facts. Assuming that radiation consists of two parts, the surface waves, which follow the earth's surface, and the space waves, it remains to be determined what are the respective functions of each set of oscillations and their method of propagation.

Of great interest is the battle which is being waged over theories of wave transmission. At the moment there is a disposition to accept the hypothesis put forward by Dr. W. H. Eccles as yielding the best explanation of the observed phenomena. This hypothesis is based on the assumption that the sun's rays ionize the atmosphere in such a way that the concentration of ions increases gradually in the higher layers of the atmosphere. In that case a ray started horizontally would pursue a curved path with its concavity towards the earth, and it is held that if the ionization be great enough any electric ray might follow and overtake the curvature of the earth.

Then there are the definite day and night effects upon the strength of signals.

There is also need for an investigation into the means to be adopted for the elimination of general atmospheric disturbance without any diminution of the intensity of the signals. The disturbances are more commonly known as "atmospheres" or "X's."

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The Marconi Tradition.

AT THE "VOLTURNO" INQUIRY. STORY OF THE DISASTER RE-TOLD. THE WORK OF THE WIRELESS. OPERATOR'S BRAVERY.

THE story of the burning of the *Volturno* in mid-Atlantic, and the summoning of ten rescuing vessels by means of wireless telegraphy, is now being re-told and carefully investigated in the calm atmosphere of the Wreck Commissioners' Court. It is the Board of Trade who ordered the investigation to take place, and the Court is presided over by the Rt. Hon. the Earl of Desart, who is assisted by the following assessors :—Commander F. W. Caborne, Vice-Admiral L. Wintz, Capt. J. Ruthven and Mr. E. C. Chaston.

On the opening day of the inquiry, November 26th, counsel appearing on behalf of the Board of Trade read a provisional list of the questions for the Court to decide, one of which is :

> What installation for receiving and transmitting wireless messages was on board the steamship *Volturno* ? Was there any emergency apparatus on board ? What was its capacity ? Was any part of the installation damaged or put out of action by the fire, and if so, when ? How were wireless messages sent and received during the time the ship was on fire, and up to what time ?

It would be improper to make any comment upon this question or upon the evidence given bearing thereon while the inquiry is in progress. But there can be no impropriety in pointing out that the line of investigation is well calculated to throw sufficient light on the points raised in this question to enable the Court to decide upon it without any difficulty.

Mr. R. B. D. Acland, K.C., who, with Mr. W. N. Raeburn, is appearing on behalf of the Board of Trade, made it clear in his opening address that the saving of the five hundred odd souls on board the ill-fated vessel was due to the aid summoned by wireless telegraphy. The trying ordeal through which those on board were passing has already been pictured to the world, but it is only bit by bit that we fully realise how painful was that ordeal. The captain, aided by his officers and men, was courageously battling with flames, when it was found that the foremast, which was right in the centre of the fire, had become insecure. If it went, all possibility of communicating with the outside world was gone, for it was to the foremast that the aerial of the Marconi apparatus was fixed. The second officer and others managed to secure the mast and keep it going until in the evening the aerial was broken by another explosion. The work of the Marconi operators under these conditions can well be imagined, and they well merited the generous tribute paid to them by Mr. Acland, who said :

> "All this time—and I think it is only fair to say so—and until the very end, the Marconi operator, following the traditions of the service, remained at his post without coming outside his house, and was the means of communicating to all the different ships which eventually came to the rescue."

When the ship's dynamo was put out of action and the power supply for the wireless apparatus failed in consequence, the operator changed over to his emergency gear, which worked well until an explosion occurred (due probably to the explosion of the rockets and cartridges), and this swept the operating cabin away. "At that time," said Mr. Acland,

> "there were ships in attendance, and the wireless had done its work, so that it was not so great a disaster as it might have been, although they had been communicating with the rescuing ships right up to the time when the aerial blew away."

When this occurred there was, according to the Marconi operator, ample power in the accumulators to have gone on longer if

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necessary and if means had been available at the time.

The first witness called to give evidence was Capt. C. E. Harwood, the master of the ss. *Narragansett*. He said he received a wireless message, S.O.S., from the *Carmania* at 7.45 a.m. ship's time on October 9th, when he was 230 miles to the southward and westward of the *Volturno's* position. He sent the message to the *Carmania*, "Coming full speed." Suggested pumping lubricating oil round the *Volturno* so as to enable the boats to get alongside.

Evidence was then given regarding the construction of the vessel and the stowage of the cargo, after which the master of the *Volturno*, Capt. F. J. D. Inch, was called, and he gave the actual story of the disaster. He told of his instruction to the Marconi operator to send out the "S.O.S" signal and of the *Carmania's* response. When he heard from the operator that the *Seydlitz* and the *Grosser Kurfürst* were coming up close he asked the *Carmania* to go in search of his two boats that were missing. The *Kroonland*, a sister ship, next put in an appearance, and so close did she come that the passengers on the *Volturno* evidently thought she was going to lay alongside, for they started shouting out to her, "Come alongside! Come alongside!" But their hopes were soon dashed when they saw her steam round the weather side of the burning vessel. Her master informed Capt. Inch by wireless that he was going to send a boat with experienced boatmen in it, but after several attempts he had to give up the task as hopeless, the heavy seas making it impossible for any boat to be out then.

There had been a series of explosions on board; at about 10 o'clock at night the magazine exploded and the aerials came down. But the wireless had done its work and the operators had stuck manfully to their posts. What happened then may be explained in the Captain's own words:

> "I went back and told the Marconi officers they need not stop in there any longer, as they could do no more. From seven o'clock in the morning up to one o'clock they had stopped there the whole time—they never came out."

Later, we find in the Captain's evidence that the Marconi officers helped him to lower passengers into the boats that had come up alongside.

Here we cannot refrain from drawing attention to one point which emerges from a perusal of the evidence, not because of its relation to this inquiry, but because, in our opinion, it emphasises very strongly a moral which cannot be too deeply impressed. It would appear that the mere knowledge that relief was coming to the unfortunate emigrants huddled together on the burning *Volturno* exercised a wonderfully soothing influence upon those on board. In the course of his evidence the third officer of the *Volturno* was asked when he received any information that the *Carmania* had answered the *Volturno's* distress signals. He replied, "I went forward with another officer from the bridge deck and we connected that on the side of the funnel and standing on the fore deck the second Marconi operator came with the news that he had communication with the *Carmania*."

> "Did you let passengers know that?"
>
> "Yes, the captain sent me aft to the passengers to tell them that the *Carmania* was coming full speed."
>
> "And then you told them that in some language or another?"
>
> "Yes."
>
> "Did that have a good effect upon them?"
>
> "Yes they quietened down quite straight."

The chief engineer, Mr. Robert Dewar, explained in his evidence that the dynamos stopped working about eight o'clock, and after that the wireless set obtained its energy from accumulators which lasted until the explosions brought the aerials down about 10 p.m. Mr. Seddon, the chief Marconi officer, was on board during the whole night—right up to the end until the ship was abandoned—with the Captain, Mr. Dewar, and others, about eight all told.

The Marconi operators on board the *Volturno* gave evidence on December 5th. The senior operator, Mr. Walter Seddon, stated that he and Mr. Pennington, the junior operator, had made several previous voyages in the vessel and continuous watches were kept in the Marconi cabin night and day, each of the operators working six hour spells. He was asleep at the time when the fire broke out, and was awakened

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by the assistant purser, who rushed to his room and cried: "Get up, the ship is on fire." The Marconi cabin was then in charge of Mr. Pennington, who had just got the *Seydlitz*, and was giving them the position of the burning ship. It would be about a quarter past seven when he had finished with the *Seydlitz*. Mr. Seddon was quite positive that it was the *Seydlitz* who was the first to answer, and he stated also that when he entered the Marconi cabin Mr. Pennington was sending out his own ship's position, which was marked on a piece of cardboard. A record was always kept of the times when distress signals were sent in the same way as a record of the time of ordinary messages was kept, and both he and Mr. Pennington were entering up communications with various steamers throughout the day.

When he took the instruments over from Mr. Pennington he sent out another "S.O.S." signal, and the first vessel he got immediately afterwards was the *Carmania*, to which he gave his position from the cardboard slip. The *Carmania* replied that her distance was about 59 miles, and that she was coming all speed to render assistance. Shortly afterwards he got the *Grosser Kurfurst*. As soon as he heard that the *Carmania* was coming he sent word to his captain by the second operator. He was able to learn the progress of the fire so as to be able to report to the *Carmania* from time to time through Mr. Pennington, who went between the captain and himself, and who brought messages from the captain which were sent to the *Carmania*. Mr. Seddon then gave particulars of some of the messages that passed between the *Volturno* and the *Carmania*. At 7.45 p.m. (ship's time) he changed over to the emergency gear, which worked very satisfactorily until the aerials were brought down by an explosion at 9.45 p.m. (ship's time). He stayed on board all night and assisted to put women and children into the boats, before leaving in the last boat with the captain, the chief engineer and some others.

At the conclusion of Mr. Seddon's evidence Mr. Dunlop, counsel for the owners of the *Volturno*, rose, and addressing the Commissioner, said:

"My lord, Mr. Seddon is not a servant of the owners, and they have asked me to take this opportunity of publicly thanking him for his services, and I gladly do so."

Mr. C. J. Pennington, the junior Marconi operator, was next called. He was in the operating room on the morning of October 9th, when he heard a cry of fire, and the captain came and told him to call for assistance. He immediately sent S.O.S., just after 7 a.m. The captain afterwards came and gave him the position of the ship—49° 12 north, and 34° 51 west—which he sent out. He got his first answer from the *Seydlitz*, about 7 minutes after calling. Mr. Seddon came into the operating room while witness was speaking to the *Seydlitz*, and took charge as soon as he had finished working with the *Seydlitz*. Mr. Seddon immediately received an answer from the *Carmania*, and told witness to report to the captain. Asked whether he reported the *Seydlitz* as well as the *Carmania*, Mr. Pennington replied: "If I remember right, the captain came to the Marconi house before he brought the position and asked me if I had received a reply, and I told him No—not then. When he brought the position, if I remember right, I told him I had the *Seydlitz*—just got him, and would then send the position to him as he had just brought it to me."

Before witness withdrew he was thanked by Mr. Dunlop on behalf of the owners for the services he had rendered to the *Volturno*.

A wireless telegraph station has been added to the electrical equipment at Columbia University, New York. This installation has been made possible by a recent gift of $8,000. The station is intended for special students sent by the United States Naval Academy to take graduate work at Columbia.

* * *

At a special meeting of the Institution of Civil Engineers, Mr. Alexander Gracie, Managing Director of the Fairfield Shipbuilding and Engineering Co., described the progress in marine construction during the past twenty years. Referring to modern developments he said:—"Wireless telegraphy, probably the greatest boon ever given to those in peril on the sea, is now installed in over 1,800 vessels and at 270 shore stations."

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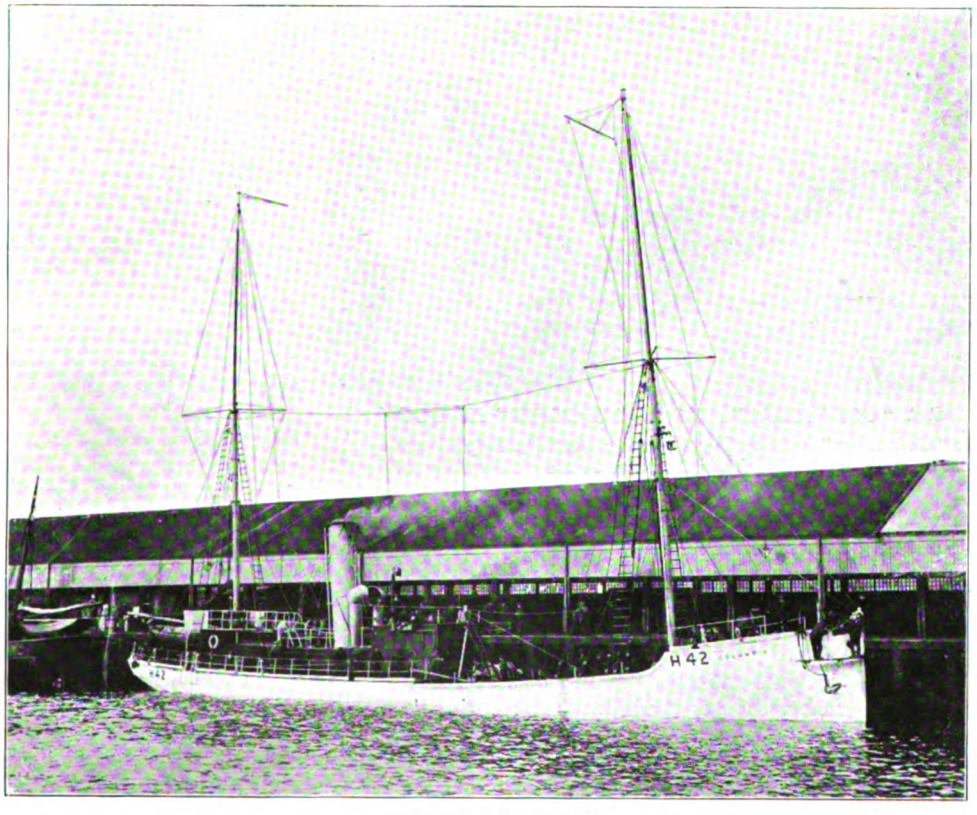
The Wireless Equipment of a Fishing Fleet

IN an earlier number of THE WIRELESS WORLD appeared an article of some length on steam trawlers and their work, but if we may be allowed to criticise our own magazine it is now, from the standpoint of recent events, out of date. For then the possibilities of wireless telegraphy, as applied to trawling, were discussed, and the preparations for its inauguration on some of the Hellyer's Fishing Fleet were outlined. Now all this has become an accomplished fact. Marconi sets have been duly installed, and have already proved the value of wireless telegraphy to the fleet in question, though it will be some considerable time before the limits of its resources can be appraised: indeed, if it ever can be, for unusual circumstances and unforeseen emergencies are sure to arise when its aid will be required, and it is under such conditions that the value of wireless is most conspicuous. Nevertheless we can confidently predict that henceforth the fortunate trawlers possessing this equipment will wonder however it was they



S.S. "COLUMBIA"

The mark-boat of Messrs. Hellyer's Steam Fishing Fleet. She is the last word in scientific equipment, for she possesses a Marconi installation, a wireless compass, directional aerials, searchlight, and electric light.

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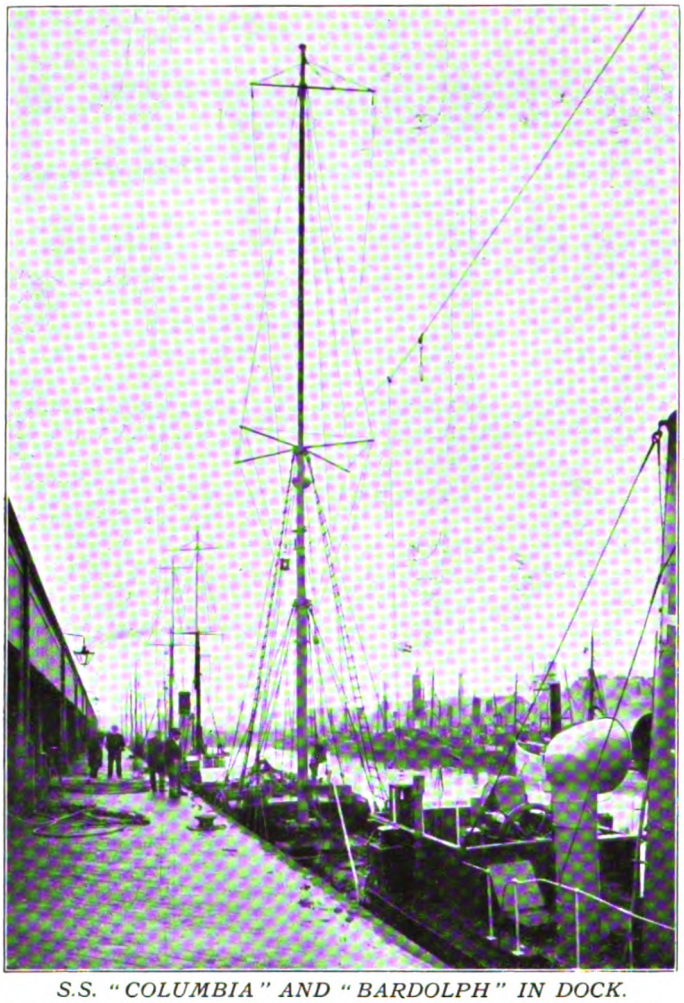

S.S. "COLUMBIA" AND "BARDOLPH" IN DOCK.

The "Columbia" is in the foreground; the "Bardolph," one of the Fleet's trawlers fitted with wireless, can be seen lower down the dock.

managed to exist without this aid to navigation and business enterprise.

For the better understanding of these advantages, let us add a parenthetic note of the system on which North Sea trawlers work.

The sixty steam trawlers belonging to Messrs. Hellyer when at sea remain close together in charge of an "admiral," or, in his absence, a "vice-admiral." His is the duty of choosing the fishing ground.

When the fleet has made a full catch, each "fleeter" transfers her cargo to a swift steam "carrier," which then travels at full speed for Billingsgate, where she discharges her cargo.

On Saturday, November 24th, two of the three vessels fitted with Marconi apparatus for Messrs. Hellyer's Steam Fishing Company left St. Andrew's Dock, Hull, for the North Sea to take their part in the new scheme of the wireless control of the fleet. These vessels were the *Bardolph* and the *Columbia*, while a few days before the *Caliban* had left the same port for the same destination and to fulfil similar service. The *Bardolph* is the flag-ship of Messrs. Hellyer's fleet, and carries the commander, "Admiral" Lynn. The *Caliban* is under the command of "Vice-Admiral" Windas, while the *Columbia* is to be "mark-boat," an office of no little responsibility. She will take up a fixed position on the Dogger Bank. This place has been fixed by the owners. The other two vessels have gone to join the fleet in their fishing operations.

In the past it has been always a matter of difficulty, and not a little expense, in the way of consumption of coal, for outward bound vessels to come up with the fleet; for the fishing ground is frequently changed, and the carrier or "fleeter" on its return from the market is often at a loss to locate its whereabouts. But under the present scheme the *Columbia* takes up her position quite independent of the fleet, and vessels proceeding to the fishing grounds first make for the mark-boat.

At night her searchlight will be in use, or rockets will be fired, and the skipper searching for the fleet will be informed through a megaphone as to the exact location of the fleet, the *Columbia* being in constant communication with the fleet. In this way much valuable time will be saved.

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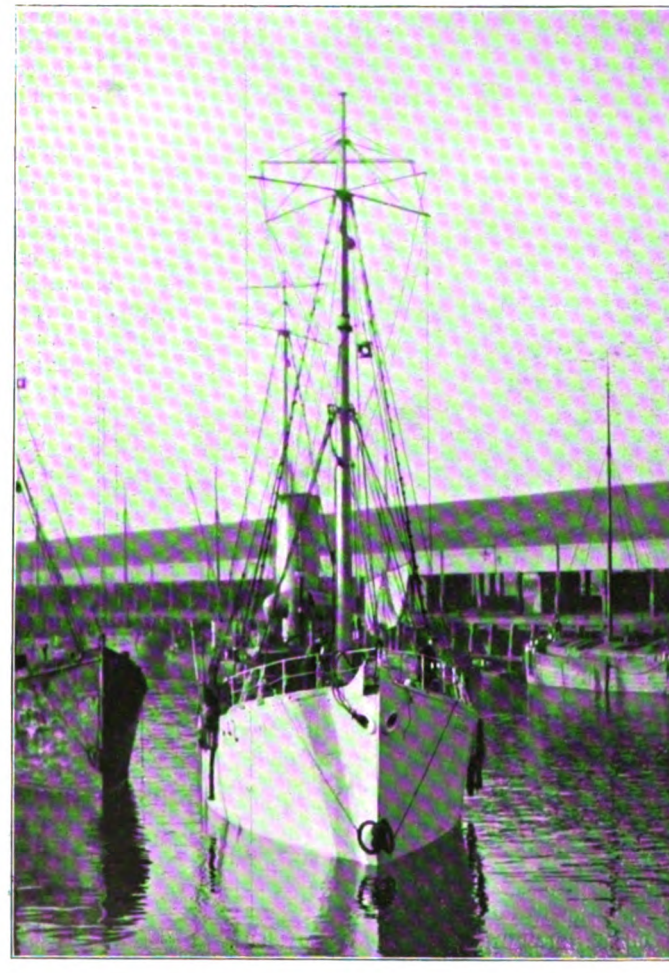
This will not be the only purpose served by the installation of the wireless. The fleet will be able, amongst other things, to ascertain, if necessary, or be informed of the state of the markets.

There was great need for improvement in this direction. The merchants have grumbled long and loud over the irregular supplies, which threaten to strangle the market at Hull. An instance in point occurred only the other day. There was not a single North Sea trawler at the Hull Billingsgate, the market being solely dependent upon four Icelandic catches. At another time it may be there is a terrible glut, and many thousands of pounds worth of good material has to be wasted. Given the general adoption of wireless, this could be avoided, and it would benefit not only the trawler-owner, but the market itself, as it is sure to have an effect on the price of fish, for owners will be able to keep themselves minutely informed of the extent of the "catches," and to order the boats home when the chance of a profitable "deal" occurs. Therefore the installation of wireless telegraphy is opening up a new era for the fishing industry, and the enterprise of such owners as Messrs. Hellyer's is likely to be amply repaid.

In due course it is anticipated that the other fishing companies will follow suit, and it is not improbable that wireless will be generally adopted by the fishing industry.

For defensive purposes the new installation will also be important. Should another Dogger Bank incident occur, as during the Russo-Japanese war, the Admiralty can be instantly informed of the circumstances.

The delight of the North Sea fishers when they found that they were to be in possession of a Marconi wireless installation knew no bounds. For a fortnight at a time or longer these hardy fellows are wont to go away, out of touch with the world and its happenings, and out of reach of such warnings as the meteorologists are able to give, even in advance of the experienced eye of the mariner, of the approach of storms. As soon as the *Bardolph* joined the fleet in the North Sea communication was established with the land, and the trawlers inaugurated their new



THE "COLUMBIA" LEAVING THE HARBOUR.

The telescopic masts, which have been invented especially to withstand bad weather, are here shown lowered. Compare them with their extended appearance in the foregoing photograph.

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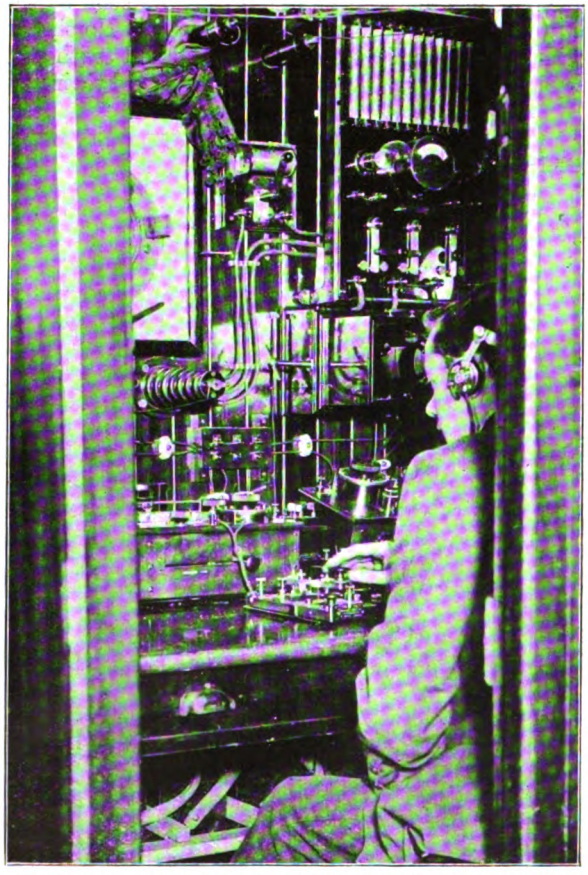
wireless installation by sending the following message to the President of the Board of Agriculture and Fisheries :—

" Greetings from Lynn Admiral Hellyer's steam trawling fleet—the first British steam trawling fleet fitted with Marconi wireless telegraph apparatus and wireless compass. Fleet now 210 miles E.N.E. from Spurn."



AN OPERATOR AT WORK ON THE " COLUMBIA."
The " Columbia " carries two operators, so that one may always be on duty.

Mr. Runciman, in reply, sent a radio-telegram to the fleet conveying his congratulations.

Other inaugural messages were also dispatched ; one was to Mr. Archer at the Trawler Insurance Company's office, St. Andrew's Dock. It read : " Radia Columbia, M.F.H. (signalling letters). To Archer, Trawler, Hull. Everything working well; 216 miles E.N.E. from Spurn.—Lynn, admiral."

This message was received by the Wireless Station at Cullercoats on the Northumberland coast, at 9.25 a.m., and it was received at Hull shortly afterwards.

Last of all was a message received at Marconi House, which ran : " Columbia 210 miles E.N.E. from Spurn, everything working well.—Admiral Lynn."

The *Bardolph* and the *Caliban* are trawlers; they have both been fitted with ½ k.w. and emergency sets ; but the *Columbia* is a " fleeter," and her rig-out is more extensive. She is equipped with a 3 k.w. and emergency set, so that she will be able to send messages over a distance of 300 miles—and more !—and besides carries a direction finder and a wireless compass. This is somewhat of a novelty among the smaller merchant vessels, though it is already in use on the more important liners and in the Navy. It enables the operator to locate with certainty the exact position of any ship calling him, and to correct her if her skipper has made any error in calculation. But these are not her only conveniencs ; her equipment is completed with an electric light installation and a searchlight. In fact, she is the last word in the application of science to everyday business. She will carry two wireless operators, so that one can always be on duty.

A meeting of the Institute of Radio Engineers was held at Columbia University on December 3rd, when Mr. E. F. W. Alexanderson, Consulting Engineer to the General Electric Company, read a paper on " Dielectric Hysteresis at Radio Frequencies."

The first meeting of the Washington Section has been postponed until January 7th, 1914.

* * *

The Admiralty have decided to establish a school for signalling and wireless telegraphy instruction at Harwich, in connection with the training establishments for boys at Shotley. The 11,000-ton cruiser *Spartiate*, at present stationed at Portsmouth as a training ship for stokers, is to be fitted for the duties of a signal and wireless telegraphy ship.

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Communications with Cavalry

WIRELESS TELEGRAPH STATIONS IN THE INDIAN ARMY MANŒUVRES.—THEIR INFLUENCE ON THE OPERATIONS OF THE DIVISIONAL TROOPS.

AN interesting example of the military uses of wireless telegraphy is furnished by the Inter - Divisional manœuvres between the 3rd and 7th Army Divisions which took place in India last year. Major D'A. Legard, of the 17th Lancers, has given in the *Journal* of the United Service Institution of India an interesting account of the means adopted for maintaining communication between the Divisions, and from this he draws important inferences as to what might have happened had there been sufficient portable wireless telegraph stations. In the manœuvres the Cavalry Division possessed two wireless stations, but these, it appears, were not sufficient to cope with the work required, and it has prompted Major Legard to consider how an adequate wireless service might have been employed. The example which he gives is important as showing how communications between the headquarters of an army and an independent cavalry can be obtained.

The general plan of the 7th Divisional Commander involved a movement to the River Jumna (the frontier) on the first day with his whole force and a subsequent crossing of that river, with a view of attacking an enemy's force which was believed to be concentrating near Sonepat. Headquarters, 7th Division, therefore, moved west from Dilaura to Bagpat, while the Cavalry Division received orders to march from Budhana to Kutana (a distance of 30 miles), almost parallel to, and about 25 miles distant from, the march of the 7th Division.

A signal company formed part of the 7th Division.

The Cavalry Division had an improvised signal squadron comprising: two wireless stations, eight cyclists, and sixteen despatch riders and signallers. Communication was established each night, but little was done during the day.

The following points seem to be necessary for the efficient carrying out of the signal service :—

(*a*) Co-ordination of the various means of communication by the O. C. Signal Squadron, who is in charge of the whole signal service of the Cavalry Division.

(*b*) Previous instruction at personal interview to be given by the G. S. O. Cavalry Division to the officer commanding Signal Squadron.

(*c*) When the Division halts, information to be given as to the probable length of halt.

(d) Arrangements to be made for supplementing the wireless with alternative methods of transmitting messages.

The accompanying diagram shows the arrangements for inter-communication which Major Legard suggests might have been made if the signal squadron had been provided with the following equipment, *viz.*: two wagon wireless stations, four pack wireless stations, eight cyclists, sixteen despatch riders and signallers.

The officer in charge of army signals, or G. S. O. II. (operations section) at headquarters, in consultation, at personal interview if possible, with the O. C., Signal Squadron Cavalry Division would draw up the following scheme for inter-communication; make arrangements for the distribution of the signal equipment and the detailing of the relay posts. For this the General Staff are responsible.

The following draft order for Force Operation Orders would then be prepared :—

Communication.—Communication will be established between headquarters and the Cavalry Division both by wireless and by a chain of relay posts, as early as the situation permits, on the lines: Daula, Baraut, Bagpat, Kutana. Detailed instructions have been issued separately.

The signal company at Divisional headquarters is jointly with the Signal Squadron

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of the Cavalry Division responsible for maintaining communication between Force headquarters and the Cavalry Division.

The distribution of the equipment, personal, would be as follows :—

With Headquarters.—Two wireless wagon stations, one wireless pack station, despatch riders.

With Cavalry Divisional Headquarters.—Three wireless pack stations, dispatch riders.

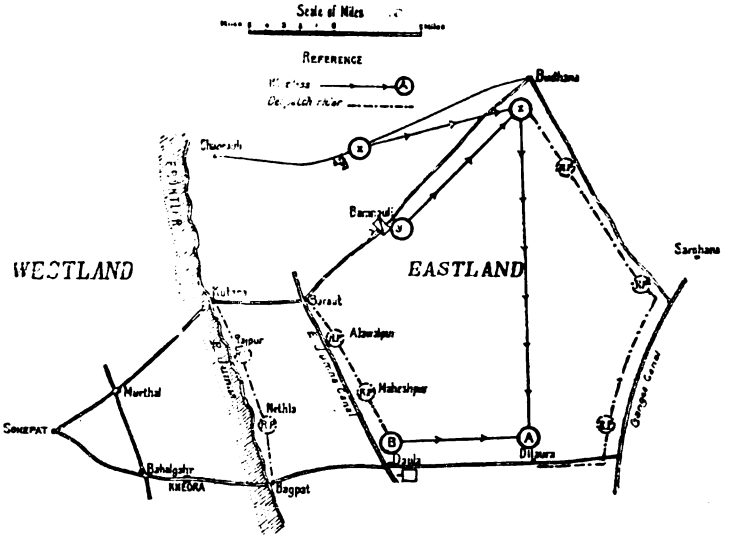
Force Headquarters would leave "A" wagon station at Dilaura all day as central signal station.

"B" wagon station would march with the Force Headquarters to Daula, where it would establish a post, and receive messages from "A" station for definite period, say, 10 a.m. till 1 p.m.

Pack station (C) would at first be in reserve ; but, if not needed, would move on and establish post at Bagpat as soon as possible. "B" station would then close, and move to Bagpat. Cavalry Division Headquarters would leave pack station (Z) at Budhana ; would march to (Y) station with the Division and attach (X) station to the reconnoitring detachment pushed out to Chaprauli. Previous information would have been given of the intention to establish (Y) station at Bamnauli 10 a.m. ; to open communication with "A" wagon station. This would allow pack station to close, and follow the Division to Baraut, where it would set up at about 2 p.m. Communication with the reconnoitring detachment (X) station would be ordered at definite hours, say, 10 a.m., 3 p.m. and 8 p.m. Communication between each headquarters and their nearest wireless station would be kept up by dispatch riders in pairs ; a pair being ready detailed as "next for duty," at the wireless station, and with the G. O. C.

Arrangements would also be made to supplement the wireless communication by a complete system of dispatch riders, just as if no wireless existed.

Major Legard then describes the system



of dispatch riders, and he gives some notes from the draft order on the subject of intercommunication. He states : "Wireless telegraph stations will be established at Baraut and at Kutana as early as the situation permits, if possible by 2 p.m. and 4 p.m. respectively. A chain of relay posts will be established on the line Baraut-Daula by 1 p.m., on the line Kutana-Bagpat by 3 p.m. The intermediate posts at Maheshpur and Nethla will be furnished by Force Headquarters. Posts at Baraut, Alawalpur, Kutana, and Rajpur will be furnished by the 2nd Cavalry Brigade. Each post will consist of : one N.C.O. and four dispatch riders. The officer detailed to

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command the posts will report at Cavalry Divisional Headquarters at 9 p.m. for special instructions."

The table below shows the method of hourly transmission of wireless messages, from Cavalry Division to Force Headquarters.

	Method.	From	Through	To
a.m.				
6	Wireless	Z (Budhana)	—	A (Dilaura)
7	Dispatch rider and wireless	Z ,,	A (Dilaura)	Headquarters
8	,,	Z ,,	A ,,	,,
9	,,	Z ,,	A ,,	,,
10	,,	Y (Bamnauli)	A ,,	,,
11	,,	Y ,,	A ,,	B (Daula)
12	,,	Y ,,	A and B	Headquarters
p.m.				
1	,,	Y ,,	B (Daula)	C (Bagpat)
2	,,	Z (Baraut)	B ,,	C ,,
3	,,	Z ,,	B ,,	C ,,
4	,,	Y (Kutana)	—	C ,,
5	,,	Y ,,	—	C ,,
6	,,	Y ,,	—	C ,,

The proposed action of the Signal Company is as follows, according to Major Legard :—

On the second day, the Cavalry Division crossed the Jumna at Kutana at 5 a.m., and marched on Lursauli, whence it operated in the triangle Lursauli, Deoru, Murthal, and finally withdrew to camp at Murthal.

The Headquarters moved from Bagpat at 4.30 a.m., and after a heavy engagement near Kheora, halted for the night near Bahalgarh.

"A" wireless wagon station would be left as central station at Bagpat. "B" station would proceed with Divisional Headquarters and be established near Kheora by 9 a.m. It would then accept all messages received meantime from "A" station. "A" station would then close.

"C" pack station would be in reserve with Force Headquarters.

CAVALRY DIVISION SIGNAL SQUADRON.

"Y" pack station would remain at Kutana to transmit messages sent by dispatch rider to "A" wagon station at Bagpat.

"Z" station would accompany Cavalry Division Headquarters in the hope of being able to set up a station during the day. This would not have been possible, and messages would have been sent by dispatch riders or helio to Kutana and thence after 10 a.m. "B" station at Kheora.

"X" station would have rejoined Headquarters at 8 a.m., with 30 Lancers, and been in reserve, ready to accompany any reconnoitring detachment.

USUAL SIGNALLING.

The signal stations at Kutana and Bagpat were established on high ground, commanding a good view of the country for a distance of 6 to 8 miles westwards, in the direction in which the troops were operating.

Signallers with the Cavalry Division and with headquarters would be instructed to call up these stations at Kutana and Bagpat, as circumstances required to supplement other means of command. Well-mounted staff officers might also have been very usefully employed to carry verbal reports direct from the Cavalry Division to the Force Headquarters.

At 5 p.m. a service of dispatch riders would be organised to work between Murthal and Bahalgarh, preferably of cyclists. Relay posts would not be needed as the distance is only 4 miles.

The relay posts on the lines: Budhana-Dilaura, Baraut-Daula, Kutana-Bagpat, would have been withdrawn by the officer in charge, Army Signals, as the need for them gradually ceased.

The Share Market.

LONDON, *December* 19, 1913.

The Share market has been dull in sympathy with Stock markets in general. Marconi International Marine Communication shares have been dealt in up to 1 3/8 cum dividend. There is a steady demand for these shares and for the shares of the Canadian and American Companies.

Prices as we go to press are:—Marconi Ordinary, £3 7s. 6d.; Marconi Preference, £2 12s. 6d.; Canadian Marconi, 16s. 9d.; American Marconi, 16s. 10½d.; Spanish and General, 8s. 9d.; International Co., £1 8s. 9d., ex dividend.

* * *

The United States Transport *Thomas*, which arrived in San Francisco on November 13th from Manila, reported that on September 24th, when the ship was near Guam, the scores of the Pacific Coast League baseball game were received on board, over a distance of 4,700 miles.

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The Transatlantic Station in Norway

A Report on the Work at Stavanger

STAVANGER is an old and venerable town, for its importance as a port was recognised by German merchants as far back as the Middle Ages. Every year these merchants sent their ships of commerce to Stavanger and Bergen, there to exchange cargoes of spices and beer for salt and dried fish. Relics of this venerable past are still to be found in the curious old houses which border the steep and narrow streets of the older part of the town, where even the more modern buildings are constructed of wood. Behind, the tower of Udlanhaug rises in lonely majesty on the top of the hill. It was built to commemorate what was perhaps the most important battle in the history of Norway, where, more than a thousand years ago, Harold Hairfair, the last of the petty kings, was killed, and the way was made plain for the ultimate unification of the kingdom.

Mr. O. Frost, the Marconi Engineer in Charge of the Construction Party at work on the Stavanger site.

It is on the slopes of this hill that the new Marconi Wireless Transatlantic Station is being built, so that from the same spot where once the Vikings watched the fortunes of their warriors as the armies engaged in the fierce struggle, now surging forward, now stubbornly retreating according to the fortunes of the battle, the spectator will now see the outward and visible signs of a nation's—nay, a world's—struggle with the elements, a complex web of iron and steel whereby the Twentieth Century takes light and sound captive, and makes them acknowledge her victory and do her bidding.

Here ten steel masts are being erected, and what was before waste land will now be utilised to the greatest good of mankind.

It may be interesting to mention some of the incidents in connection with the preparation of the foundations for these masts. Excavation on such a stubborn mountain is no light task. First the workmen drill a hole in the rock some ten feet deep, then insert a cartridge and blast it so as to increase the excavation to a size sufficient to contain the charge of dynamite. After they have ignited the fuse they walk away. But they are in no hurry—no Norwegian workman ever was in a hurry; and the fact that they are engaged in a very dangerous occupation does not seem to occur to them, for, after all, are they not expert exponents of the material they use, quite inured to its eccentric behaviour and proof against surprise? Nevertheless, they have a care for their fellow workmen, for as they retreat they cry "Se op! Se op!" A minute later and the eruption will take place, the broken rock will be scattered far and wide, and the fragments flying through the air will loom large through the clouds of smoke and dust. To the workmen nothing could be simpler; they know exactly where to drill the necessary holes and how much dynamite to use to obtain the desired result, and they have attained such accuracy in this respect that seldom is a fraction of rock more than that absolutely necessary dislodged.

The Norwegian labourer is very independent, and usually prefers "piecework" to "time." Often several friends will join

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together and secure a contract, which they will carry out between themselves. A group of this kind usually comprises four to six individuals. If they are particularly anxious to secure the price of the contract they will work for long hours and very steadily without much intermission for rest or meals.

For instance, in the making of a road, six men, it may be, will contract to do a certain length at a given price — one will supply horse and cart and the others will provide their equivalent of labour; one will break stones, another will set them, and so forth; and when they have finished the contract that part of the road will be complete in every detail.

The temporary Office of Works for the new Station. This was formerly a refreshment hall.

It is in this way that the road up to the Marconi Station is being constructed; it is in two sections, the first part leading from the main road to the machine house, and the other part, which is very circuitous owing to the steep ascent, leads to the top of the hill and the Marconi masts.

At the bottom of the hill a cottage is situated named "Fieltun" (The Mountain Knoll), which has hitherto been used as a country inn. From this place there is a fine view over the Hafrs-Fiord, and it has therefore been a favourite excursion for the Stavanger people to go out there and take afternoon tea during the summer. The innkeeping had, however, to stop as soon as its purchase for the Marconi Station was complete, for the house, on account of its position, was too useful to be allowed to remain a little insignificant tea-shop. Therefore it is now used as a temporary office for the Marconi engineers and the Government's officials, but it often happens that on a sunny afternoon visitors enter the hall and expect to be served with tea. Needless to say, in this respect they are disappointed, though if they like they can find in its new use abundant food for thought, which should last them many a day.

About 500 yards from these offices a landing stage has just been finished; at this spot motor lighters and small steamers discharge loads of cement, sand and other materials for the wireless station. Only small ships can enter here, and larger boats have to discharge their loads at the celebrated old Stavanger harbour.

Here, where once upon a time none but German sailing ships made anchor, there are now to be seen steamers of all nationalities. Just as in the old days, the chief export article of Stavanger is fish, not only salt and dried fish, but tins of delicious sardines, of which Stavanger exports more than any other town in the world, or nearly one million pounds' worth every year. During the past autumn, however, the inhabitants of Stavanger have been in great distress, for the sardines have not yet reappeared.

Blasting a hole in the rocks for the foundations of one of the masts.

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Snow in Midsummer: one of the sights to be seen on the railway journey from Kristiania to Bergen.

Shoals of them usually arrive off the coast about August, and consequently it is during this month that the inhabitants expect to make by far the largest amount of their year's income; but for some reason or other the little fish have forsaken their usual haunts, and the town will be deprived of its principal source of revenue, while the tourist visiting Stavanger will miss the characteristic smell of fish, which persistently hangs over the town much in the same way as a fog occasionally hangs over London.

The "Hermetic" factories will have to reduce the number of men employed, perhaps even to close down for a time, for want of fish to fill their tins.

Stavanger is only accessible from the sea, and the journey to the capital, Kristiania, is celebrated for its varying scenery. The traveller can go by boat the whole way to Kristiania, but this is a journey of about three days' duration, and many people therefore prefer to take the boat going north to Bergen, a very beautiful old town, whence one can go by rail across the country to Kristiania. This journey is famous, for the route winds its way in curves right up to the eternal snow at Finse, where winter sports can be enjoyed even in the hottest part of the summer, and where the four seasons of the year may be experienced in the course of a single day.

A bird's-eye view of Bergen from the Wireless Station at Stavanger.

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Contract News

Vessels fitted with Marconi Apparatus since the last issue of *The Wireless World*.

Name.	Owners.	Installation.	Call Letters.
Glenetive	Caledonia S.S. Co.	1½ kw. and emergency	MEZ
El Cordobes	British and Argentine Steam Navigation Co.	,,	MHO
Galiano	Canadian Government	,,	—
Scindia	Anchor Line	,,	MHJ
Berrima	P. & O. Steam Navigation Co.	,,	MFF
Pera	,, ,, ,,	,,	MGB
Khiva	,, ,, ,,	,,	MGZ
Baron Erskine	Hogarth & Son	,,	MHF
San Valerio	Eagle Oil Transport Co	,,	MHZ
San Hilario	,, ,, ,,	,,	MIZ
El Toro	Lobitos Oilfields, Ltd.	,,	MHD
S. Y. Alberta	J. B. Cohn, Esq.	,,	MHW
Limerick	New Zealand Shipping Co.	,,	MHU
Highland Hope	Nelson Line	,,	MEO
Chateur	Royal Mail Steam Packet Co.	,,	GMN
Chignecto	,, ,, ,,	,,	MBV
Historian	T. & J. Harrison	,,	MHT
Raeburn	Lamport & Holt	,,	MES
Kelvinian	J. Black & Co.	,,	MGQ
Carpentaria	British India Steam Navigation Co.	,,	MHG
New Londoner	Tyne and Tees S.S. Co.	½ kw. and emergency	MDQ
Parana	Royal Mail Steam Packet Co.	,,	GLK
Nonsuch	Bowles Brothers	Emergency Plant added	MYH

Orders have been received to equip the following Vessels with Marconi installations since the last issue of *The Wireless World*.

Name of Vessel.	Owners.	Type of Installation.	Call Letters.	Remarks.
Potosi	Pacific Steam Navigation Co.	1½ kw. and emergency	MII	Liverpool to Valparaiso.
Inca	,, ,, ,,	,,	MIF	
Magellan	,, ,, ,,	,,	MIH	
Corcovada	,, ,, ,,	,,	MIE	
Sorata	,, ,, ,,	,,	MIJ	
Orduna	,, ,, ,,	,,	MGP	Pacific Coast Mail.
Orbita	,, ,, ,,	,,	MGI	
Orca	,, ,, ,,	,,	MGO	
Imperial	Cia Sud Americana de Vapores	,,	CAI	South American Pacific Ports.
Baron Erskine	H. Hogarth & Sons	,,	MHF	General cargo.
El Gorro	Lotutos Oilfields, Ltd.	,,	MHE	Oil tank steamer.
Crown of Toledo	Crown S.S. Co., Ltd.	,,	MHV	General cargo.

The following Vessels have been fitted by the Société Anonyme de Télégraphie Sans Fil.

Name.	Owners.	Installation.	Call Letters.
Sir Ernest Cassel	R.L.O.	1½ kw. and emergency set	SFP
Madioen	Rott. H.	½ kw. and emergency set	PGI
Ambaca	E.N.N.	,, ,, ,,	CSY
Malange	E.N.N.	,, ,, ,,	CSN
San Miguel	E.I.N.	,, ,, ,,	CSS
Ioannina	N.S.N. Co.	,, ,, ,,	SVI

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Europe's Time Signaller

THE EIFFEL TOWER SERVICE. AN EXPLANATION OF THE SIGNALS.

LITTLE did M. Eiffel suspect the uses to which his Tower was destined to be put. It has lately taken on itself some of the functions of a newsagent by dispatching wireless each morning and evening news to the French warships and the military posts in Morocco, and as all know, it was chosen by an International Conference in 1912 to signal the hour to the rest of Europe. This is done at a number of fixed times, and the signals themselves are of two kinds—the first of which are " ordinary " hourly signals, exact to a quarter of a second, while the second signals furnish the mean time according to the Observatory of Paris to the scientific observatories of other countries.

Automatic time signals are at present transmitted by way of experiment from the Eiffel Tower at 10 a.m. daily ; and at the second International Time Conference, held in Paris last October, the question of definitely putting them into operation was discussed, and it was finally decided to postpone doing so, as the signals do not give entire satisfaction, and they will have to be modified.

On November 15th, however, one or two alterations were introduced into the Eiffel Tower service. Thus, the duration of the signals sent out each evening at 11.30 p.m. are extended to five minutes instead of three minutes, while before the morning and night signals there is transmitted daily a series of six dashes of five seconds each, separated by intervals of five seconds also. The two six-figure code signals sent after the time signals at night represent in minutes, seconds, and one-hundredths of a second the precise time at which the first and last of the 300 rhythmic beats are sent out. These 300 beats have a periodicity of 0·98 seconds ; this is to say they are seconds diminished by one-fiftieth.

Apart from these time signals there are a number of signals connected with the meteorological service. These are of two kinds, the first of them affording an indication of the barometric situation of Europe as a whole, and derived from information supplied by Iceland, Ireland, France, Spain, the Azores, and America ; the second of them sending out similar information regarding the state of the weather for fourteen stations in Western and mid-Europe, from Stornoway to Rome, from Prague to Biarritz and Stockholm. These telegrams are, of course, all coded, and numerals are employed to convey intelligence concerning the strength and direction of the wind, the state of the sky, and the state of the sea.

The Central Meteorological Office have issued a manual of the Eiffel Tower wireless service, from which we make the following extracts relating to the two meteorological reports that are transmitted.

These reports are preceded by the initial letters BCM (Bureau Central Météorologique).

(1) The morning report is transmitted at 10.49, immediately after the time signals commencing at 10.45 a.m. This time may be modified at a later date when the new time signals come into force. *Note.*—See letter from Commandant Ferrié.

(*a*) Six groups of 7 or 8 figures indicating the barometric pressure, the direction of the wind, state of the sky, and state of the sea. (This last figure appears in the groups containing 8 figures.) These groups are preceded by one or two initial letters indicating the name of the station referred to. R= Reykiavik (Iceland) ; V=Valentia (Ireland) ; O=Ushant (Brittany) ; CO=La Carogne (Spain) ; HO=Horta (Azores) ; SP=Saint Pierre (America).

(*b*) Following the six groups of figures general atmospheric conditions for various parts of Europe are telegraphed in plain language (French).

(*c*) Groups of 7 or 8 figures giving the same observations for Paris : C=Clermont-Ferrand ; BI=Biarritz ; M=Marseilles ; N= Nice ; A=Algiers ; SY=Stornaway ; SH= Shields ; HE=Helder (Holland) ; SK=

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Skudesnaes (Norway); ST=Stockholm; P=Prague; T=Trieste; R=Rome.

(*d*) General forecasts for France concerning the state of the sky and wind.

(*e*) The direction and force of the wind at the Eiffel Tower, 305 metres above ground, and probable wind for evening. This last information, for the use of aeronauts, is preceded by the initials FL; the velocity of the wind is indicated in metres per second.

Second Weather Report.—A second report is sent at 17 (5 p.m.). It amplifies the morning report and takes into account variations which have been observed since 7 a.m., and to give a more precise forecast for the next day.

(*a*) The report consists of 8 groups of figures similar to the morning report for the following places: Paris: BR=Brest; BI=Biarritz; N=Nice; V=Valentia; SK=Skudesnees; R=Rome; CO=La Corogne.

(*b*) Forecasts of the weather.

(*c*) The direction and velocity of the wind at the Eiffel Tower at 16 (4 p.m.) and a forecast for the wind and weather for the following morning. The report is made from observations made at 14 (2 p.m.).

EXAMPLE OF MORNING WEATHER REPORT.

BCM — R5132811 — V57422445 — O64522544—CO67530183 - - - - - Depression N.W. Europe forte pression S.W. Paris 6512031 * * * * * * Probable vent W. modéré averses Nord et Est—FL SW. 13 probable W. 10.

EXAMPLE OF EVENING WEATHER REPORT.

BCM—Paris 6262030—BR 65224455—BI — XXXXXXXX — N 62222211 — V60022425—SK 36024655—R 6142030—CXXXXXXXXX — Baisse barometrique Baltique stationnaire — Manche — Vents tournant N.W. fortes Manche Mediterranée. Averses—FL W. 10 probable W. 8.

The translation of the above is effected in the following manner: The first three figures represent the barometric pressure in millimetres and tenths of a millimetre, the figure 7 always preceding the figures telegraphed. The 4th and 5th figures indicate the direction of the wind. The 6th the direction of the wind. The 7th the state of the sky. The 8th the state of the sea.

The first group in the morning report is R5132811, which is translated below.

R = Reykiavik; 513 indicates that the barometric pressure was 751·3 millimetres; 28 = direction of the wind N.W.; 1 = force of the wind, nearly calm; 1 = sky, slightly cloudy.

The second group, V57422445.

V = Valentia; 574 = barometric pressure; 757·4 millimetres; 22 = direction of the wind W.S.W.; 4 = force of wind, moderate; 4 = state of sky, covered; 5 = state of sea, very choppy.

When observations have not come to hand XX is sent, thus the third group of the evening report is BIXXXXXXXX, which signifies that the report from Biarritz had not arrived in time to be dispatched from FL.

For further information on the subject of time signalling, etc., we would refer our readers to articles which appeared in THE WIRELESS WORLD for August, 1912 (p. 297) and October, 1912 (p. 454).

Direction of Wind. 4th and 5th Figures.		Force of Wind. Designation velocity in metres. 6th figure.		State of Sky. 7th Figure.	State of Sea. 8th Figure.
00 No wind ...	18 S.S.W. ...	0 Calm from	0–1	0 Fine	0 Calm.
02 N.N.E. ...	20 S.W. ...	1 Nearly calm	1–2	1 Light clouds ...	1 Very smooth.
04 N.E. ...	22 W.S.W. ...	2 Very light	2–4	2 Cloudy... ...	2 Smooth.
06 E.N.E. ...	24 W.	3 Light ...	4–6	3 Very Cloudy ...	3 Slight waves.
08 E.	26 W.N.W. ...	4 Moderate ...	6–8	4 Covered ...	4 Choppy.
10 E.S.E. ...	28 N.W. ...	5 Fairly strong	8–10	5 Rain	5 Very choppy.
12 S.E. ...	30 N.N.W. ...	6 Strong ...	10–12	6 Snow	6 Rough.
14 S.S.E. ...	32 N.	7 Very strong	12–15	7 Mist	7 Very rough
16 S. ...	—	8 Violent ...	15–18	8 Fog	8 Very high Sea.
—	—	9 Gale ...	18–	9 Storm	9 Tempestuous.

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Answers to Correspondents

BY OUR IRRESPONSIBLE EXPERT

MARINER (Cardiff).—The wireless compass is an apparatus which enables a ship to see where it is going without looking.

S. PARKS (Darjeeling).—Yes, most of the Indian land stations are fitted with tea aerials. You are wrong, however, in supposing that the "sausage" aerial originated in Germany.

SCEPTIC (Surbiton) writes as follows: "Sir,—I recently received what was alleged to be a Marconigram from my brother on board one of the large liners. I had previously suspected that wireless was a fraud, and when I found that this so-called telegram was *not in my brother's writing* my suspicions were confirmed!"—Answer: My dear Sir, if your brother's writing is no better than your own alleged writing it is a credit to wireless that any message came through at all.

MUSICAL (Birmingham) writes: "Dear Sir,—I am very much worried about my multiple tuner. I have turned the intensifier handle at all speeds, but fail to produce any tunes. My mother is very anxious to hear 'The Rosary' on it, so I should be glad of your advice." Answer: We strongly suspect you have burnt out the insulation by trying to play rag-time. Set the tuning switch at 600 meters and try "What are the wild waves saying?"

CONSTANT READER (Margate).—An "X" in wireless is something which comes when it is not wanted. There are two main sorts—the atmospheric kind and the retransmission variety. Both are a great source of annoyance to operators, hence the name "X," which is a polite sign for bad language. Means have been found to eliminate the first kind to a great extent, but no "X" eliminator yet devised has been able to keep out the retransmission messages. They creep in through the strongest insulation.

J. G. W. (Leeds).—The wireless telephone is a telephone without wires, poles, exchange girls or other similar obstructions. It is invented regularly every week in one or other of the halfpenny papers. It depends for its working on the production and emission of continuous waves. The present wire telephone seems to necessitate (on the part of the subscriber) continuous raves. The great difficulty encountered at present in wireless telephony is to find a microphone strong enough to carry the wireless current and bad language as well.

AMATEUR (Tooting).—Carborundum is used in the Marconi crystal receiver. It has been found that this substance resists mildew very well and is not easily bent. It acts by virtue of its high resistance. The current finds such difficulty in passing through one way that it does not think it worth while to go back again. The current is thus rectified and produces a tick in the telephones. The Fleming valve acts in a similar way by making things hot for the current. We hope this is clear.

TWO WIRELESS MISTAKES

According to the Paris *Daily Mail*, during the recent French army manœuvres an invitation was transmitted by wireless asking several officers to "lunch." The sapper was unacquainted with the English word "lunch," and sent "punch." As a result the officers who were invited had their lunch first and went, expecting only liqueurs. To avoid being rude, they had to eat another lunch, and were much discomfited.

This reminds us of the newly married officer (probably in the same regiment) who invited an intimate friend to lunch, and afterwards sent a wireless message to him: "What do you think of my wife?" The sapper who sent it (probably the same sapper) sent it as "What do you think of my wine?" The friend, who was busily engaged in getting rid of the nasty taste of the officer's wine, sent a wireless back: "Rather sour and no body." The victim of the duel died shortly afterwards. The reader will draw probably the same conclusion from both stories.

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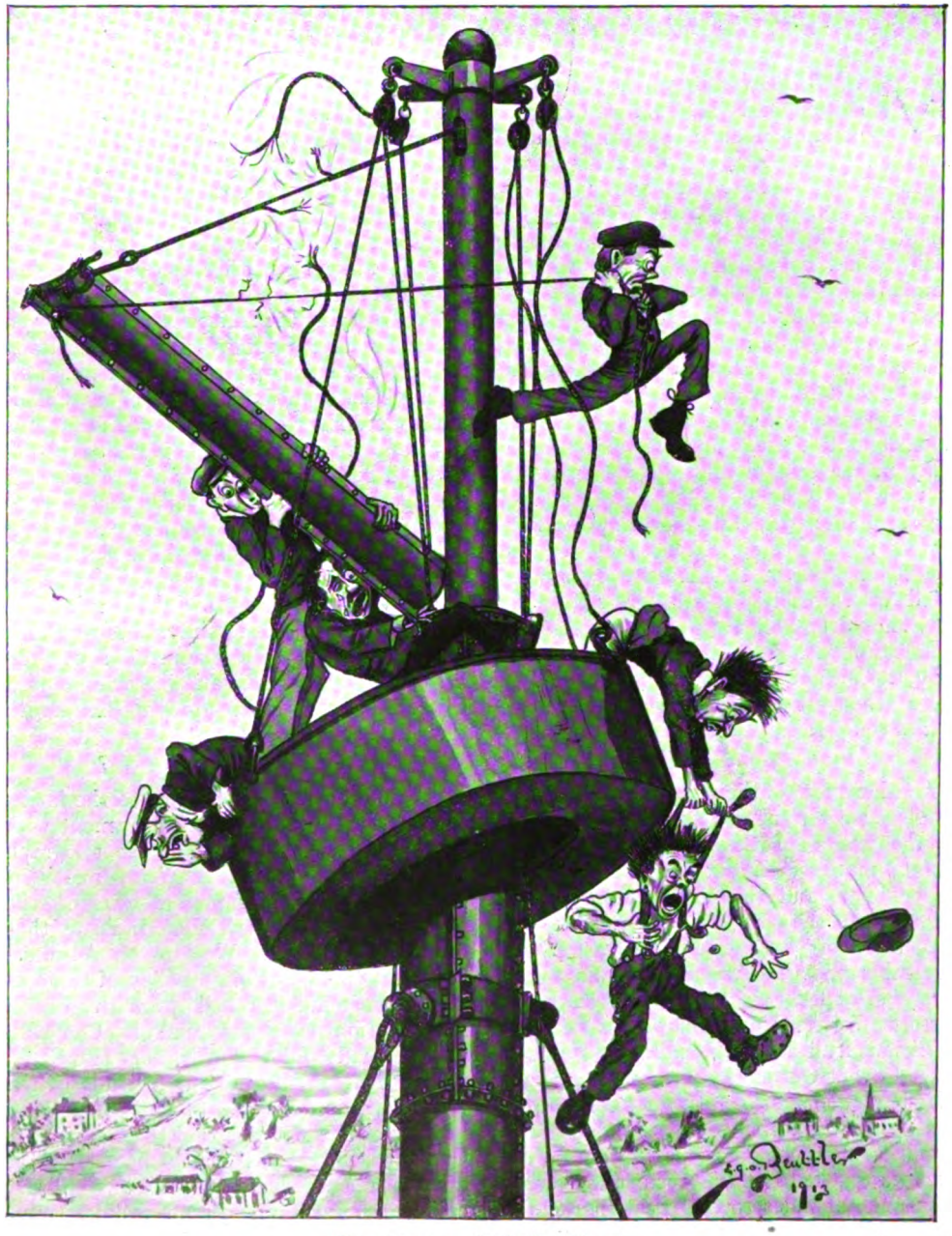
CARTOON OF THE MONTH

WIRELESS WORRIES—I.



Erecting a 400-ft. Mast.

D

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NOTES OF THE MONTH

A WELSH STATION. HOW WIRELESS AIDS THE BANANA TRADE. PUBLIC CONTROL IN THE UNITED STATES. FRENCH-AMERICAN EXPERIMENTS. MARCONI DIVIDEND ANNOUNCEMENTS.

MUMBLES wants a wireless telegraph station, and the Swansea Chamber of Commerce are supporting the local demand for one. At a recent meeting of the Chamber the question was introduced by Mr. A. G. Moffatt, who said he thought it would not be long before all passenger boats would be bound to have a wireless installation, even those which carried passengers across to Devonshire! The question was where were the messages to be received ashore? It was essential, he contended, there should be a station at the Mumbles, for if messages had to be received at Poldhu or Fishguard there would be considerable delay in the case of anything occurring in or near the Channel. The advantage of the Mumbles was that there were tugs always ready there, and as most of the ocean-going vessels touching Swansea were fitted with wireless, it was essential that they should be able to get into direct communication with the port, and it was agreed that the matter should be brought before the Harbour Board with a view of the two bodies co-operating to secure their object.

* * *

Another proof of the value of wireless telegraphy as a commercial asset has just come to the notice of the public in a rather curious manner. A tax has been proposed on bananas, and this has served to draw attention to the remarkable organisation of this transport business. The writer can remember the time when a banana was a rarity, or at least an important item on the dessert list. Now this delicious and nutritious fruit floods the market. Hawkers leave Covent Garden Market every morning with barrows laden with this delectable commodity, and it forms one of the staple food supplies of the poorer population. The fruit is packed while green and rushed thousands of miles to the great markets of the world in a few days, so that it may be in prime condition when it is sold to the public. And so carefully is this business of transportation organised that millions of bananas are brought from the tropics every day for home consumption, but great judgment has to be used in the packing and transport of this perishable cargo. The banana must be neither too green nor too ripe, and every care has to be taken that the vessels carrying the fruit may not be delayed on their long journey. As a precaution against the latter possibility, wireless telegraphy has been found to be of invaluable assistance. Every vessel engaged in the trade is equipped with a wireless plant, so that if, through bad weather or any other cause, the transport should be delayed, she can send out a wireless call for assistance, and all the help possible can be offered her so that as much time as possible may be gained, and the chances of her cargo rotting in the hold may be reduced to a minimum. How many, we wonder, of the consumers of bananas have realised what an important part wireless has played in supplying them with their delicacy.

* * *

Speculation has been rife as to the intention of the United States Government with regard to the acquisition of the telegraph and telephone lines. Inquiries made at Washington by a representative of the *Electrical World* of New York indicate that the report that the Washington Administration is to embark on a policy of Government ownership is based primarily on an investigation now being made by Congress man David John Lewis, of Maryland, rather than on the present attitude of the Administration itself. Some colour has been given to the report that the Postmaster-General is interested in the matter by the announcement that the Alaska military cable and telegraph system will be transferred from the War Department to the

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Post Office Department. This system comprises 2,500 miles of submarine cable, 1,200 miles of land line, and ten wireless telegraph stations. Major Charles McKay Salzman, of the Army Signal Corps, has been transferred to the Post Office Department temporarily in connection with the proposed change in control of this property. The War Department wants to be relieved of its duty with respect to the Alaska lines, pointing out that they are not needed now for purely military purposes. Whether any particular significance with respect to the larger subject of government control of other lines can be attached to this matter cannot be learned in Washington.

* * *

A delegation of French scientists, composed of Martial Simonin, of the Observatory of Paris, Captain A. Carrier, of the Colonial Infantry, and Lieutenant Gignon, of the Navy, recently visited Washington for the purpose of renewing wireless experiments between Arlington station and Eiffel Tower. A similar delegation, composed of Lieutenant R. B. Coffman, C. A. McGruder, George S. Gillespie, and G. A. Hill, of the Naval Observatory, Washington, together with Commander H. H. Hough, naval attaché at Paris, represented the United States at Paris in connection with the experiments at Eiffel Tower.

This is the second series of an extensive programme of experiments which has been mapped out by the naval officials of the two countries to use the wireless apparatus at their disposal for fixing the difference in longitude between Paris and Washington, and also obtaining other data for use in connection with astronomical calculations which would otherwise be impossible.

The officers of each navy will work alternately in Washington and Paris, in order to eliminate error, as far as possible, arising from personal equation. The astronomical instruments used in the observations will also be exchanged between the two countries to correct any slight variations due to mechanical imperfections in the construction of the apparatus.

* * *

The following circulars, signed by the Secretary, Mr. Henry W. Allen, were issued on December 13th to shareholders in Marconi's Wireless Telegraph Co., Ltd., and the Marconi International Marine Communication Co., Ltd.

WIRELESS CO.

"I beg to inform you that at a Meeting of Directors of this Company, held on the 11th instant, it was

Resolved—

That an interim dividend of ten per cent., equal to two shillings per Share, less Income Tax, upon the 750,000 Ordinary Shares, numbered 1 to 500,000 and 750,001 to 1,000,000, be, and the same is hereby declared, on account of the current year; that the said dividend be payable on the 31st January, 1914, to the Shareholders registered on the books of the Company on the 24th December, 1913, and to Holders of Share Warrants to Bearer; and that the Transfer Books be closed from the 24th to the 31st December, 1913, inclusive.

Warrants for the dividend upon the registered Shares will be forwarded by post on the evening of the 30th January next.

Notice will be given in due course regarding the deposit of coupons for the payment of dividend on Bearer Shares by advertisement in newspapers in London, Brussels, Italy, Montreal, Buenos Aires and the United States."

The Preference dividend of 7 per cent. per annum to 31st December, 1913, was paid on October 1st last, and consequently the Preference Shares and the 750,000 Ordinary Shares will not rank equally for any further dividend which may be declared in respect of the year 1913.

INTERNATIONAL CO.

"I beg to inform you that at a Meeting of the Directors of this Company, held on the 11th instant, it was

Resolved—

That an Interim Dividend of five per cent., equal to one shilling per Share, less Income Tax, upon the Capital now issued and paid up, be, and the same is hereby declared, on account of the current year; that the said dividend be payable on the 31st January, 1914, to the Shareholders registered on the books of the Company on the 24th December, 1913, and that the Transfer Books be closed from the 24th to the 31st December, 1913, inclusive."

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Administrative Notes

Compulsory Wireless on Ships.

THE Consul-General for Argentina in London reports the publication of a law by which all ships entering or leaving Argentina ports with 50 or more persons on board must possess a wireless telegraph installation, under the charge of a competent operator. For use on river steamers the wireless must have a range of not less than 200 kilos. (about 125 miles) and for sea-going vessels a range of at least 500 kilos. (about 310 miles). Vessels not complying with the regulations will not be cleared.

* * *

India Army Regulations.

THE Government of India has sanctioned the attachment of 18 men drawn from volunteers from the British units to No. 41 (Wireless Signal) Company for six months, with effect from November 15th, 1913, for instruction as operators in wireless telegraphy. These men receive four annas per diem, in addition to the regimental pay, proficiency pay and allowances. The qualifications are as laid down in India Army Order 492, September 15th, 1913, omitting sub-paragraph (vi) and paragraphs (v) and (vi). Preference is given to young soldiers of mounted units who are first-class signallers. The men must be willing to transfer eventually to No. 41 (Wireless Signal) Company. For the purpose of signalling inspections, qualified signallers absent on this duty are counted as first-class signallers of their unit.

* * *

Regulations in Mauritius.

AN ordinance has been issued which consolidates the laws on wireless telegraphy in Mauritius. Under this ordinance no person shall establish any wireless telegraph station or install or work any apparatus for wireless telegraphy in any place or on board any ship registered in the Colony except under and in accordance with a licence granted by the Governor. Every such licence shall be in such form, and for such period, as the Governor may determine, and shall contain the forms, conditions, and restrictions on and subject to which it is granted. No person shall work any apparatus for wireless telegraphy installed on any merchant ship, whether British or foreign, while that ship is in the territorial waters of the Colony, otherwise than in accordance with prescribed regulations.

* * *

Wireless in Southern Nigeria.

AN ordinance has been issued providing for the regulation of wireless telegraphy in Southern Nigeria. Under this ordinance no person may establish a wireless telegraph station or install or work any apparatus for wireless telegraphy in the Colony except under a licence granted by the Governor. Merchant ships in the territorial waters of the Colony must not use wireless telegraphy in such a way as to interfere with naval signalling, or with the working of wireless stations established in the Colony. Merchant ships must not work wireless telegraphy whilst in any harbour or bay of the Colony, except with the special permission of the Governor.

* * *

Wireless on the Canadian Lakes.

THE new law passed by the Canadian Parliament regarding the wireless telegraph service on Canadian vessels sailing on inland waters comes into force on January 1st, 1914. Section 4 of the Act reads as follows: "From and after January 1st, 1914, no passenger steamer, whether registered in Canada or not—(*a*) licensed to carry 50 or more persons, including passengers and crew, and going on any voyage which is or which includes a voyage of more than 200 nautical miles from one port or place to another port or place; or (*b*) licensed to carry 250 or more persons, including passengers and crew, and going on any voyage which is or which includes a voyage of more than ninety nautical miles from one port or place to

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another port or place; or (*c*) licensed to carry 500 or more persons, including passengers and crew, and going on any voyage which is or which includes a voyage of more than twenty nautical miles from one port or place to another port or place shall leave or attempt to leave any Canadian port unless such steamer is equipped with an efficient radio-telegraph apparatus, in good working order, capable of transmitting and receiving messages over a distance of at least 100 nautical miles by night and by day, and in charge of a person fully qualified to take charge of and operate such apparatus.

"2. The owner, master, or other person in charge of any passenger steamer which leaves or attempts to leave any Canadian port contrary to the provisions of this section shall, on summary conviction, be liable to a fine not exceeding $1,000 and costs, and such fine and costs shall constitute a lien upon such passenger steamer.

"3. This section shall not apply to passenger steamers plying on the rivers of Canada, including the River St. Lawrence as far seaward as a line drawn from Father Point to Point Orient, or on the Northumberland Straits, or on the Georgian Bay, or on the lakes of Canada other than Lakes Ontario, Erie, Huron and Superior; and the provisions of paragraph (*c*) of sub-section 1 of this section shall not apply to steamers making voyages on Lakes Ontario, Erie, Huron and Superior the regular route for which is not at any point more than seven miles from the shore.

"4. This section shall not apply to steamers calling at Canadian ports solely for the purpose of obtaining bunker coal or provisions for the use of such steamer, or through stress of weather, or for repairs."

* * *

THE call letters SOW have been assigned to the s.s. *Carioca*, owned by the Brazilian Government.

* * *

THE Marconi depot at Genoa has been transferred from Molo Vecchio to Piazza della Commenda, No. 67.

* * *

THE Post Office wireless telegraph station at the Lizard has been closed and the staff transferred to the new coast station at Land's End, which was opened for commercial work on December 1st, 1913.

* * *

THE following Marconi stations have been opened to the general public service. Full particulars concerning them will be published in an early issue of THE WIRELESS WORLD:—

Cabo de Palos: Call letters, EAP; range, 270 miles; continuous service; Coast tax, 4½d. per word (minimum, 10 words).

Finisterre: Call letters, EAF; range, 270 miles; continuous service; Coast tax, 4½d. per word (minimum, 10 words).

* * *

IT is stated the Canadian Government have decided to erect a wireless station on Chatham Point, British Columbia.

* * *

THE Norwegian Post and Telegraph Department is said to have under consideration a scheme for the erection of a series of wireless telegraph stations around the coast from Christiania to the Swedish frontier in the south and to the Russian frontier in the north. There will be fourteen stations in all.

* * *

THE Portuguese Government are contemplating an extension of the system of wireless telegraph stations on the Continent and in its colonies. The stations at Lisbon and Oporto are well advanced, and that at the capital will be equipped with apparatus of sufficient power to communicate over a distance of 2,200 miles by day, and twice that distance at night.

* * *

AS a result of the recent storms and floods in Ohio, Pennsylvania and West Virginia, especially in the Ohio valley, the proposition to construct a chain of wireless stations from Pittsburgh to Cairo, Ill., is again being brought to the attention of the public. According to the *Telegraph Age*, the city council of Youngstown, Ohio, have taken the matter up in earnest and have granted a franchise for the establishment of a wireless station in that city.

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Maritime Wireless Telegraphy

WE are indebted to Turner, Davidson & Co., Ltd., who act in London on behalf of Lane & Dawson of Sydney, N.S.W., for a cutting from an Australian contemporary, which we print below. It will be noticed that wireless telegraphy was utilised to fix a charter while the vessel was at sea, and we would commend the matter to the attention of our readers, not only for this interesting fact, but further because it demonstrates the value to owners of sailing vessels of wireless telegraph equipments.

"WIRELESS CHARTER.

"*Sydney Bound Six-Master Fixed. A New "Departure.*

"There are not many sailing vessels carrying a wireless outfit, but the *Everett G. Griggs*, a six-master, is one of the few, and because of this has just made a good deal.

"The vessel left Tacoma, Puget Sound, on 7th July, with a full timber cargo on board for Sydney, consigned to Davies and Fehon, and is, therefore, 67 days out. She may be expected to show up at any time. During the last fortnight Lane and Dawson have been trying to pick her up, and they sent a message to the Sydney G.P.O., with particulars of a wire for Captain Sterling concerning a charter-party. On receipt of these particulars, the radio people got in touch with half a dozen steamers fitted with wireless, and these joined in the search for the big barquentine. This morning at 2 o'clock the answer came back, having been received by the Brisbane radio from a steamer, name not known, but which had been in touch with the *Everett G. Griggs*. Captain Sterling, who is owner as well as master of the sailer, was in a position to act promptly, with the result that the vessel has been chartered at a profitable rate to carry a cargo of 4,000 tons of coal to Callao, on the west coast of South America. Mr. Lane, principal of the firm of Lane and Dawson, referring to the matter, said :—

This is probably the first time a sailing vessel has been fixed by wireless, and as showing the value of such an installation it can be said that the rates for this charter could not be repeated to-day, because there has been a decrease since the *Everett G. Griggs* was placed under offer.' The only other sailing vessel trading to Sydney to have a complete wireless outfit is the White Star training ship *Mersey*. The *Griggs*, as she is known, is not a stranger to Sydney, nor is Captain Sterling, and on the last occasion when she was in these parts the captain announced that he intended reorganising the wireless department on board, which was only a small affair, into something on a larger scale. He has done this. This morning's message did not indicate the position of the vessel, but it is reckoned she is somewhere to the east-north-east, and may be heard of direct in a day or two. Her wireless call letters are 'V.G.R.'"

* * *

On November 15th last, at one o'clock a.m., the wireless station on board the s.s. *Gelria* was in communication simultaneously with the coast stations at Olinda (distance 1,540 miles), Cadiz (1,755 miles), and Dakar (710 miles), thus linking up the continents of Europe, Africa and South America.

* * *

The Federal authorities at Baltimore, Maryland, have fined the captain of a North German Lloyd steamer, which has just arrived at this port, the sum of £20 for neglecting to maintain constant wireless service on board his ship. There was one wireless operator, but not two as required. This is the first fine under the law passed recently.

* * *

Great suspense reigned at Sault Ste. Marie on account of the non-arrival on schedule time of the Great Lake s.s. *Huronic* of the Northern Navigation Co. The *Huronic* when in Lake Superior on her way from Sarnia to the Soo encountered heavy gales and was reported to be in difficulties. The

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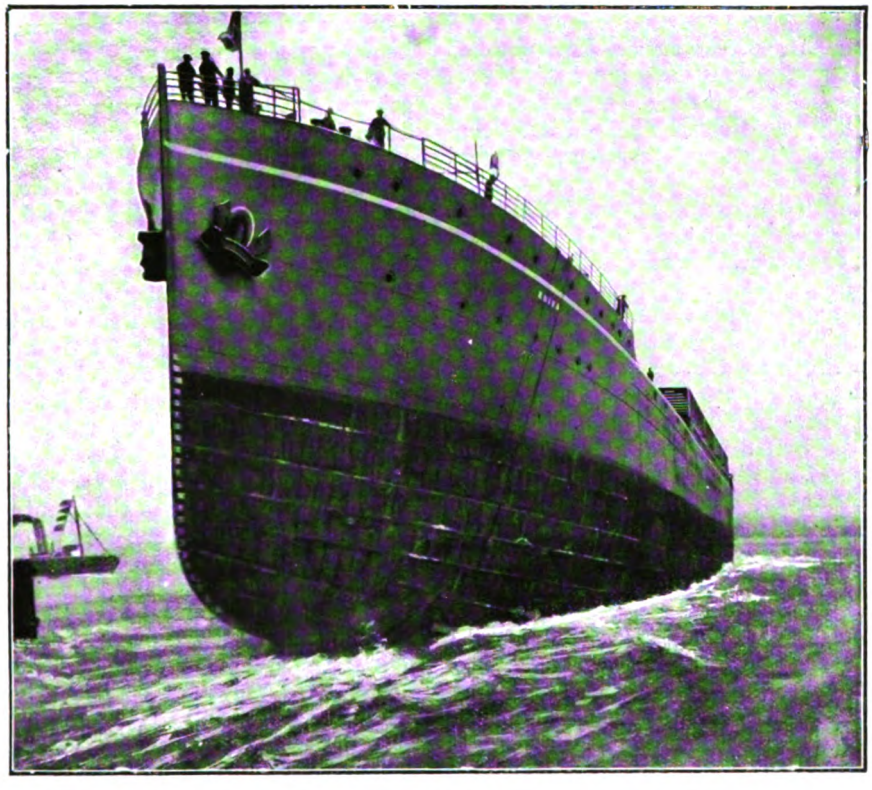
anxiety on the part of the friends of the passengers on board was, however, happily allayed by a wireless message from the ship that was relayed on to Soo advising them that the vessel had taken shelter from the storm and was proceeding undamaged. The liner arrived at her destination some twenty-four hours overdue.

* * *

Birkenhead was recently *en fete* for the launch of a new P. and O. liner, the *Khiva*, which is being built by Messrs. Cammell, Laird & Co. for this well-known steamship line. The *Khiva* is a striking example of the developments of mercantile shipbuilding of the first class, and represents the latest phase in the construction of the intermediate passenger and cargo boat. She is built of steel, and carries a Board of Trade passenger certificate. She has a top-gallant forecastle for the accommodation of the native crew, and bridge and poop-houses fitted for the accommodation of passengers, officers, and engineers. The vessel is divided by eight water-tight bulkheads, all extending up to the upper deck. Accommodation is provided for 79 first-class passengers, in cabins on the upper and bridge decks, and 68 second-class passengers, in cabins also on the upper deck. Refrigerating machinery has also been installed on the vessel, and large chambers have been set apart for the storage of meat and provisions. Steam is supplied by four boilers, each having four furnaces. A Marconi 1½-k.w. set will be installed on the vessel, the receiving and sending house for the operator being erected on the bridge deck.



s.s. "Khiva"

* * *

The owners of the British steamer *South Point*, bound from London for Philadelphia, received a wireless message on November 8th, advising that this vessel broke down in mid-Atlantic and has been picked up "by the British steamer *Rappahannock*, 700 miles west of Queenstown.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

For Synopsis of the Characters in the story, see previous chapters.

CHAPTER X.

"THE COURSE OF TRUE LOVE NEVER DID RUN SMOOTH" (*contd.*)

THEN, too, whenever they were all together Braithwaite seemed to take most of Gwen's attention, and practically controlled the entire conversation. Matters, however, reached a climax one day when, after Charles had suggested an excursion across the Downs for mushroom picking and had been put off by one of the usual excuses, he found on his return from a solitary walk that the two had been spending the afternoon at Chittingham's latest attraction, a third-rate picture palace. Charles determined to have the matter out and made an early opportunity to speak to Gwen alone. In a tone that left no room for refusal he invited her into his study. Then the accumulated chagrin of the past few days was given voice, and he spoke with bitterness and impatience which she was little accustomed to, and which, indeed, was so unlike the speaker's usual procedure that when he came to think of it afterwards, he could only explain his conduct by the fact that he was overwrought with worry and was more used up than he was aware by the efforts entailed in bringing his recent invention to completion.

"Look here, Gwen," he said, "I am rather tired of this game. For the past fortnight you have been behaving abominably to me, and as for that fellow Braithwaite, the way you are carrying on with him is a scandal. All the village is talking about it, and though I may be a bit of a softy in the usual way, I am not going to be made a fool of before the whole neighbourhood. If you are really anxious to improve your acquaintanceship with—my friend—you are quite at liberty to do so. But you can't expect me to stand that kind of thing without a murmur. I have always let you have your own way and you can have it now; you have only got to tell me that you prefer your own friends to my humble self, and I will retire gracefully, but—there's no need for you to get angry, you know perfectly well that I have good enough cause for my remarks—but, I was going to say,you needn't expect that you can dangle me by the end of a string, so that you can call me to your side as soon as you have finished with the other fellow. Now what are you going to do? You can take me or leave me as you choose, but you have got to do either one thing or the other. If you don't want our engagement broken off, you must at least expect to fulfil your part of the bargain, and that is to fall in with some of my wishes and some of my plans, or if you don't always want that, to ask me to take part in some of yours. Of course, I quite understand your interest in fresh faces, and I shouldn't dream of getting in the way of your pleasure, but all I ask is that you may do sufficient to keep up appearances, and to show at least that you are willing to give up something for me. If you can't see your way, the best thing for us is to break the engagement entirely; don't let's have any silly make-believe."

He broke off abruptly, and poked the fire, for the evenings were getting chilly, then sending the irons clattering to the hearth, he waited for her reply.

Gwen was furious. The onslaught was so sudden that she had scarcely time to think of defending herself. In her heart of hearts she knew that Charles had some reason for his remarks, but that made them all the harder to bear. She came closer to him, her face white with suppressed emotion, her lips compressed, bloodless and trembling.

"I think you are a cad." She whispered rather than spoke the words, looking Charles full in the face. "A terrific cad, to speak like that. You have no right to. If you don't think I know how to behave, you had

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better find somebody else, for I'm not going to be taught what I ought to do by you. You are not even a sportsman to trust me, and I hate a man who isn't a sportsman. If you don't like what I have been doing, why didn't you speak to me before ? You have let things go on as though you didn't care, and then you bully me for them afterwards. It is positively cowardly, and I am not going to stand it ! "

She turned round, struggling against her feelings. Charles noticed the action, and immediately reproached himself for having spoken so harshly. He would have given worlds to have taken back his words, but it was no good now. However, he did attempt to make the *amende honorable*.

" Come, Gwen," he said, in a conciliatory tone, " it is not quite so bad as that. I don't think I'm a cad or a coward. You know you *have* been teasing me horribly lately by the way you have been flirting with young Braithwaite, and I'll own that I was nettled just now. But don't you see it's rather rough luck on a chap to be treated in quite the way I have been ? You must own that it's not altogether nice to see the person you love most carrying on with somebody else, for you can't deny that you *have* been flirting, and flirting desperately. There's no getting away from that."

" I'm sure I haven't," Gwen objected ; then added illogically, " and, even if I have, there's nothing better to do here ; besides, as I said before, can't you trust me ?"

" Yes, that's all very well, you know, but it's playing with fire, for you really are awfully headstrong. You'll get into a mess before you know where you are, and I'm sure Braithwaite is not worth the fuss you are making of him. You must own you don't look before you leap, or at least those foreigners of yours ought to have taught you that. Whatever their purpose was, they were up to no good. You yourself must acknowledge that."

Poor Charles ! In his efforts to be conciliatory he had made a false step, and given Gwen a chance for recriminations. She took advantage of it, and fired up immediately.

" Well, if you weren't a cad before, I think you are one now. You bring up those foreigners against me, and if, as you say, they were up to no good, you were almost as much to blame in cultivating their acquaintance, for if you didn't agree with my knowing them, you needn't have invited them to your show. And then to turn round and speak as you did just now of your own friends is a miserable action. I'm sure it shows up your quality of friendship in a very unfavourable light "—and she put a fine sarcasm into her words. " It was I certainly who made the acquaintance of Dupont and Beulner, and you have every right to say what you like of them, but it would be well to remember that Braithwaite is *your* friend, and if I take up with him it is with a person whom *you* chose to cultivate. If he's good enough for you, I don't see why he shouldn't be good enough for me, and, if you don't think him good enough for either, then why do you pretend to be friendly with him ? It is the most downright piece of snobbery and humbug I have ever heard."

" But——"

" I suppose you are now going to make excuses. I don't see how you can very well. All I have got to say is if your affections are as valuable as your friendship I think I am well quit of both, *of both*—mind you."

With that she turned away from the window where she had been standing and went towards the door. Charles said nothing. He dared not speak, for he knew he could not explain himself. She turned at the door, and the handle rattled in her nervous grasp. Then Charles roused himself.

" Gwen ! " he called in a choking voice. " Gwen !"

She said nothing, only turned to look at him, her lips still compressed and bitter. But as she passed out, Charles saw that there were tears in her eyes.

Here was a *debacle* ! After Gwen left him, Charles sat for some time in profound meditation staring into the fire. He did not know what to do. The quarrel was altogether most absurd. In spite of contrary appearances, he thought he could gauge Gwen's feelings better than she could herself, and he was positively certain that in the long run she would find Braithwaite's company irksome. That was not to say that she would ever renew advances to him. He was aware that she was much too proud to do that kind of thing, but he did not want her to spoil herself by an infatuation, real or supposed, with one whom he was convinced was entirely unworthy of her, and who was

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merely amusing himself. As he thought of the whole episode, something like despair crept into his heart. Nothing could be done, at least he himself could do nothing, for whatever steps he might take would be interpreted as the action of a self-interested person. That was not really the case. His affection was much too deep for mere self-interest, and he would willingly have obliterated himself if he thought that by doing so she would be happier; but his convictions pointed to an opposite conclusion, and this only gave an added sting to his gloomy forebodings. Try as he would, he could see no likely way out of the uncomfortable situation, either for her or himself, and he was forced to the rather hopeless conclusion that it was best to let things take their appointed course, and see what would come of it all. To him this was not only the cruellest course, but the most difficult to pursue, for he would have to take the part of an unwilling spectator who watches every phase of a rather dingy drama, and is powerless to assist either by action or advice.

It was no wonder that he could not concentrate on the book which he held in his hands when such thoughts were driving through his brain, and what made matters worse was he could hear the light-hearted conversation in the adjoining room. Gwen's laughter rang out frequently, and it was usually followed by Braithwaite's cultivated ululation. As he noted it, it struck him that this word was the only one which would express its combination of calculated harmony and its effort to express both flattery and condescension, tinged with just a touch of conceit. Gwen's merriment sounded a little forced. Charles's accustomed ear could distinguish that; but after the scene which had just been enacted between them this was not surprising. Nevertheless it was not calculated to add balm to his already injured feelings; in fact, it so worked on his nerves that he was just going to take up his cap and brave the stormy night in order to get away from the sound, when a ring at the door bell stopped him in his purpose. Had it been at any other occasion, he would not have noticed the occurrence, for visitors were frequent at the Vicarage, and might be expected at any hour of the day. As it was, he only waited in his study until the visitors, whoever they might be, should be out of the way. He heard the maid go to the door, and then usher the visitors into the drawing-room. They were men, by their footsteps, but he was surprised when a tap came on his own door, and the maid announced that some gentlemen from London had come to see him. He immediately went to his visitors, and found three of them, all clad in mackintoshes and bowler hats, for the night was rainy. There was nothing about them to signify whom they might be, or what they might want, though the fact that Braithwaite was with them, and seemed to know them, caused him some astonishment; but he was not long left in doubt of their mission. At his appearing they rose simultaneously, and one of them, assuring himself that his host was Mr. Summers, informed him that they had come on important business. With a quick look to see if the door was shut, he told him without further ado that he was under arrest. Charles was staggered. Already shaken by the quarrel with Gwen, he was not in the least prepared to face an emergency of this kind, and, turning pale to the very lips, he staggered backwards as if he had received a blow. Then quickly recovering himself, he demanded the reason for this action, and asked to be shown the warrant. This request the detectives immediately complied with, and he read there that he was charged with complicity in selling valuable military secrets to a foreign government (unknown). He read it through, scarcely comprehending its meaning, and looked inquiringly at the detective.

"That, sir, is the warrant," replied the officer, "which I was charged to execute this evening. I understand that the case is important, and I have been given orders to bring you direct to London. I trust, sir, you will not hinder me in the duty that I have to perform, but I must add that if you compel me to use force, I have been given full powers to use my own discretion as long as I fulfil my undertaking; but I have no doubt you will help me. May I rely on such assistance?"

Charles gathered his scattered senses together. "Of course, I shan't hinder you in any way," he said, "but you will understand that this has come as rather a shock

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to me, and I don't know quite what to do. My father will be very upset if he thinks I have been placed under arrest, especially on such a charge. Of course, I protest my innocence, but that has nothing to do with what concerns us now. I don't know whether you understand how I am placed. It will do me a great deal of injury if the knowledge of this unhappy affair were to get about."

"There's no need that it should do so, sir. We had instructions that everything should be done as quietly as possible, and I see no reason why you shouldn't say that you have been suddenly called away to some friends. I quite sympathise with you about what you should say to your father. Or, better than that, you have been negotiating with the Government about some apparatus, haven't you? Couldn't you tell him that you are wanted immediately to explain some difficulties to the authorities?"

"Yes," said Charles, relieved to think that there was some way of ameliorating circumstances, "I think that would be best. Will you allow me to go to him?"

"Certainly, sir; but I should be glad if you will be as quick as possible, for my instructions were not to allow a moment's unnecessary delay."

Charles thanked him and went out of the room. He found his father and sister and Gwen together in the dining-room, and, with as much composure as he could command, he told them of what had happened; but even the most euphemistic phraseology could not make the news very palatable, and blank astonishment, mingled with some degree of consternation, was apparent on all three faces. Mr. Summers was the first to speak. "Poor old chap! What a thundering nuisance these officials are! I wish you had never muddled up in the business. They are worrying your very life out; but let's hope you will be able to settle their questions without much difficulty—and, if you can't—well, see them to blazes. Anyway, when you are away, keep us posted up with news of how you are getting on. We shall be worrying about you till we hear. Now, Alice, come along, for I am sure Charles would like to have a little talk with Gwen before he goes. We'll be in your study, old boy, till you want us."

With that he left the room, followed by his daughter. Charles did not see them go out. He was looking at Gwen, his heart torn with mingled affection—and yes, it was true—a little resentment and pain. She had turned deadly white, and did not stir from the chair she was sitting in, only twisted her handkerchief as though she would wring the thin fabric into shreds.

"Gwen," he said, but he dared not come closer, "I have been arrested."

She leant abruptly forward, and her eyes stared with fear.

"Yes," he continued, "I am charged with selling military secrets to a foreign Government, so I do not know what is going to happen to me; there are three detectives waiting to take me away. I am to go to London, but what happens then I do not know. Only nobody here is to know about it, not even Pater or Alice. As far as the neighbours are concerned, I have gone off to visit some friends. I shall not tell Pater any more than what I have just said; only I thought you had better know, in case I want any help. You know more about my private affairs than anybody else, and, should I need it, you will help me, Gwen, won't you?."

"Yes," she said, "yes," and then, hesitatingly, "of course."

There was silence for a minute, which Charles interrupted with the remark, "I'm awfully sorry that this should have happened just now, because I didn't want to force myself on you in any way, but I have no one else whom I can speak to. There's one thing more I do want to say, though, while we are alone. I don't know how long I shall be away—it may be months, it may be years. It's just this, if I should not be able to clear myself of this charge, I should not think of asking you to reconsider the decision you made this evening; but I don't see how I can be convicted, and, if I am right in my belief, perhaps you will be able a little later on to think of me more kindly. I am sorry I spoke so abruptly just now; I know I was a bit harsh, but I can swear to you that I still love you, and if you think you will be able to love me—not now, but when you have had plenty of time to make up your mind—then perhaps you will let me renew our engagement."

He waited for Gwen to make some re-

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mark, but she said not a word, only continued to wring that unoffending handkerchief as though murder were in her heart. She was proud, she was ridiculously proud, for although she loved Charles wholeheartedly, and much too deeply for such a little tiff as that which had lately occurred to alter her affection, yet she could not have given way just then to save her life—no, not if all the universe were tumbling in ruins beneath her feet. When he got no reply, Charles's heart sank, but he was never one to be beaten in his purpose. He drew off a ring which he wore on his finger. It was an old sardonyx cut square and engraved with the crest of the family, "a mailed fist," the deep stone being attached by a swivel to the gold band which passed round the finger. He came near and offered it to Gwen.

"Gwen, don't be angry if I ask you to take this. We've been old pals long enough to understand each other. Whatever happens, I don't see why we shouldn't always be pals, so will you keep this for me while I am away? Keep it until you are absolutely determined that you don't want me, and if in a year's time you feel you really don't, then send it back, and I'll know what you mean. That's not asking too much of you, old girl, is it?" and there was a caress in his voice as he stooped down to her. Gwen moved slightly, but the action was more as if to get out of his proximity than for any other reason. Nevertheless, although her attitude was apparently so cold, it was not entirely due to pique. It was practically subconscious, for she was bewildered by the situation and by her conflicting emotions. She was still young and unsophisticated, and this sudden climax of events after her unusually quiet and peaceful life, found her unprepared for the emergency. She did not even offer to take the ring. Charles let it fall into her lap. Then, to end this painful scene, he went to the door and called his sister, and asked her to pack a dressing case for his journey. She had already done this, and there was no sense in delaying longer. With a last word to Gwen, and an affectionate good-bye to his father and sister, he left them together, and went to meet his new acquaintances in the drawing-room.

"Gentlemen," he said, "I am at your service. How do we get to London tonight?"

"There is a motor-car waiting for us. It will not take us long to reach our destination," was the reply.

"Let us be going, then," said Charles.

One of the men relieved him of his bag, then, putting on his grey coat and jamming his hat on his head, for the storm outside seemed to be increasing, he went to the door. After seeing his companions out, he slammed it behind him, and his heart was heavy as he went out from the warmth of his old home into the darkness of the autumn night.

It was a miserable little group that sat in the dining-room after Charles had left. Old Mr. Summers was more upset than he cared to own. He sat in his armchair trying to read, but the result was a failure. Presently he put his book down and sat glaring into the fire, now and then making ejaculations which indicated the train of his thoughts. He stigmatised the whole episode as "devilish rot," and all Government officials, more especially those at the War Office, as "bloodless" and "nincompoops." Miss Summers was weeping quietly, while Braithwaite felt and looked uncomfortable. There was a feeling of tension in the air, for the recent events had taken them by surprise, and they had all guessed by Charles's demeanour that the matter was of greater consequence than his words implied. Gwen seemed the least affected. As far as outward demeanour went, she was simply dull and apathetic, and had the others been less concerned with their own affairs, they would, under the circumstances, have been surprised. As it was her attitude passed unnoticed. Presently she rose to go, and the ring which had remained in her lap fell to the floor. She took it up mechanically and placed it on her finger. Then with just a good-night and a kiss to Miss Summers, she went out. Braithwaite was waiting in the hall to help her into her cloak, and was evidently prepared to accompany her home. At first she refused, but custom was stronger than her personal feelings, and together they trudged through the muddy lanes. The young man endeavoured to start a conversation, but she would have none of it, nor even deigned to reply to his remarks, so that the walk was finished in silence, and, as a matter of fact, her companion did more

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to further his cause by his silence than he would have done by talking or showing sympathy; for, had he known it, Gwen was violently angry with him. Strung up as she was, he seemed to her to be the embodiment of the whole affair. The row had come about through him, and although reason told her not to judge a man without apparent cause, she laid the arrest at his door. She did not even say good-night to him when they parted, but leaving him at the gate, walked quickly up the drive and let herself in. Then, without waiting to take off her wet cloak, she went to her bedroom and, throwing herself into an armchair, sat with her hands clasping her knees in gloomy thought. She was perfectly oblivious to everything but her miserable feelings, and when she woke from her reverie she found herself cold and stiff. She rose and went downstairs to warm herself, but all the house was in darkness and the inmates had long since gone to bed. Mechanically she began to undress, but her brain felt strangled, and it seemed to her that her heart lay like a leaden weight against her side. She could not get to sleep, but twisted about as though in her body she was actually suffering the tortures of her mind. Had she analysed it, it was remorse which was wearing her out, but she only knew that she hated herself more than she could bear. At last the dawn began to glimmer. It was as though the herald of a new day had brought fresh hope, a clearer air, a softer influence. She ceased from kicking against the goad of recent events, and in the end she wept. The cleansing tears ran hot as they coursed down her cheeks; but gradually these, too, became softer and calmer, till at last she sank to sleep. When the maid came to wake her mistress in the morning she found her still sleeping, and, with a good sense uncommon to her kind, left her sleeping.

CHAPTER XI.

A KINGDOM FOR A STAGE.

Meanwhile Summers had been driven quickly to London to the War Office. Sir Henry Dever was waiting for him. The iron man of war received him very kindly, and did his best to mitigate the unpleasantness of the proceedings, for it was unpleasant, to say the least of it. Charles was told that he must consider himself practically under arrest, and that for an indefinite period. Arrangements had been made for him to sleep at an hotel for the night, but he was not to be without his escort, who would remain with him, although they had orders not to interfere with his liberty in any way if he, on his part, would give his parole not to attempt to escape from them. Then he would be drafted to the wireless station at Caister, where preparations were already in hand for his coming. He was there to build an airship after his design—two, if time permitted. He would be given every assistance by the authorities, and a sufficient complement of men had been drafted to the station to ensure the utmost rapidity of execution.

"But," Charles objected, "I have none of my plans, and I can't get on without them."

"That matter has been settled," replied Sir Henry, and at the same time drew from his pocket a familiar packet. To Charles's intense astonishment, they were all his papers—the rough drafts, and it seemed every sheet that he had ever scribbled upon with notes of his invention. "These," said the Under-Secretary, "I think, are the plans you want. They have been secured under your very eyes, Mr. Summers, and I think that is sufficient proof that we have acted wisely in taking the course we have. This incident alone establishes the fact that you are not careful enough to be allowed to act on your own responsibility. Braithwaite has secured all these papers, and you have not even discovered your loss, although they were in my possession two days ago."

Summers felt confused and annoyed, especially as he had to acknowledge that Sir Henry was quite correct in his assumption.

"But," continued Sir Henry, "I want to make it quite clear to you that there is every need to push on as fast as you can with your work. War may be declared any day, in fact it is not a question of days, but of hours."

(To be continued.)

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INSTRUCTION IN WIRELESS TELEGRAPHY

Crystal Receivers (III.)

(Ninth Article.)

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appeared on page 461 of the October number.]

BEFORE leaving the subject of crystal receivers one important point still requires explanation, namely, why it is necessary to adjust the initial voltage across the crystal to the exact point where the effective resistance of the crystal commences to decrease rapidly.

63. Referring again to the characteristic curve of a carborundum crystal shown in Fig. 1, which has already been explained in paragraph 58 of the December number of the WIRELESS WORLD, it will be remembered that we showed how a certain increase in the voltage across the crystal will have a greater effect upon the current passing through the crystal after the point A is reached than before that point is reached.

Although it is obvious that the crystal will be more sensitive when the point A is reached, it is not quite so obvious why it is necessary to adjust the initial voltage across the crystal exactly to the point A, and not to any point beyond it, such as the point, B, shown in Fig. 1.

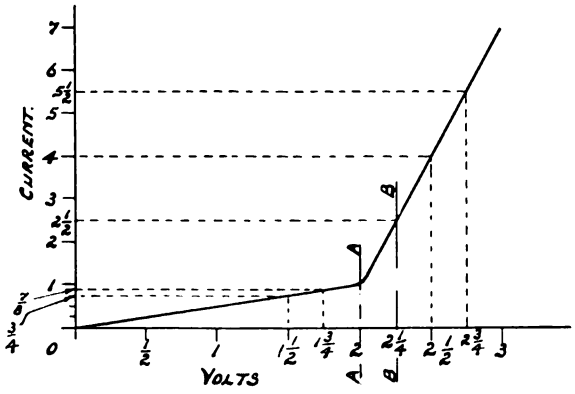

Fig 1.

As can be seen from this curve, a given increase in voltage will cause practically the same increase in current passing through the crystal whether this increase be applied at the point B or the point A, but we must remember that the **extra voltage** provided by the oscillatory current in the secondary of the jigger is an alternating current voltage, that is to say, a voltage varying from a positive value at one instant to a negative value at the next instant.

Since the **initial voltage** applied across the crystal is a direct current voltage obtained from the potentiometer, it follows that the alternating current voltage will at one instant be assisting the direct current voltage and at the next instant opposing it.

For the sake of argument let us put these voltages into figures.

Let us suppose that the initial voltage across the crystal to bring it up to the point A is 2 volts, and the voltage required to bring it up to the point B is $2\frac{1}{4}$ volts, these voltages being positive volts.

Let us also suppose that the value of the alternating current voltage varies from *minus* $\frac{1}{2}$ a volt to *plus* $\frac{1}{2}$ a volt, it is obvious then that during the time that the oscillations are being received the **resulting voltage** across the crystal, if the initial voltage be adjusted to the point A, will vary from $1\frac{1}{2}$ volts to $2\frac{1}{2}$ volts. Similarly, if the initial voltage across the crystal be adjusted to the point B, the **resulting voltage** will vary from $1\frac{3}{4}$ volts to $2\frac{3}{4}$ volts.

Now let us draw two separate curves showing the **result of this variation in voltage on the current passing through our telephones,** taking our figures from the curve shown in Fig. 1.

The curve in Fig. 2 shows the resulting current in the telephones when the initial voltage of the crystal is adjusted to point A.

At this point the value of the current passing through the crystal and telephones *before any oscillations are produced in the*

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secondary is 1, therefore we may draw a heavy line DD representing the normal value of the current.

When the negative part of the first oscillation is applied across the crystal, the result, as already explained, is to reduce the voltage to 1½ volts, thus the current passing through the telephones will be reduced, but, as will be seen by referring to Fig. 1,

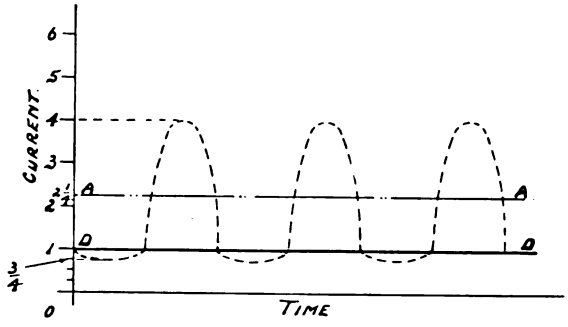

Fig. 2.

owing to its being on the flat part of the curve, the reduction in the amount of current passing through the telephones is extremely small; by reading from the curve we find it is reduced to the value of ¾.

Therefore, the curve representing the actual current passing through the crystal and telephones when the negative part of the first oscillation is applied will dip just below the line DD.

The next half of the oscillation is positive and therefore has the result of increasing the voltage across the crystal to 2½ volts.

By referring again to Fig. 1 it will be seen that the effect on the value of the current is to increase it to 4.

We may, therefore, continue our current curve in Fig. 2, which will now show the current rising to the value 4 above the normal line DD.

A similar cycle of events will take place for each oscillation, with the result that we get a series of high peaks above the normal current line, and a series of very shallow peaks below this line.

These oscillations are taking place at the rate of perhaps millions per second, according to the length of wave which is being received.

If the wave length received is 100 feet, the number of oscillations per second, as explained in the July number of THE WIRELESS WORLD, will be 10 millions per second.

These variations are infinitely too rapid for the diaphragm of the telephone to follow, and it will therefore be deflected to an extent corresponding to the **average** value of the current passing through it.

Referring to Fig. 2, the average current passing through the telephones when the oscillatory voltage is applied across the crystal is shown by the dotted line AA, drawn approximately half way between the highest and lowest point on the curve. This value is somewhere about 2¼, and therefore the sound produced in the telephones will be proportional to the difference between the normal current passing through the telephones and the increased current due to the oscillating voltage applied, *i.e.*, the difference between 1 and 2¼.

Now let us see what takes place **if we adjust the crystal to the point B;** obtaining our values of current as before from the curve in Fig. 1, we find that the result of the oscillatory voltage is to vary the value of the current from ⅞ to 5½, and we may therefore draw a new curve as shown in Fig. 3 representing this variation in the value of the current.

Again, these variations in current are too rapid for the diaphragm of the telephone to follow, so that it will again be deflected to an extent corresponding to the average value of this current.

The average value of this current will be about 3, so that we may draw a dotted line, BB, representing the average value of the

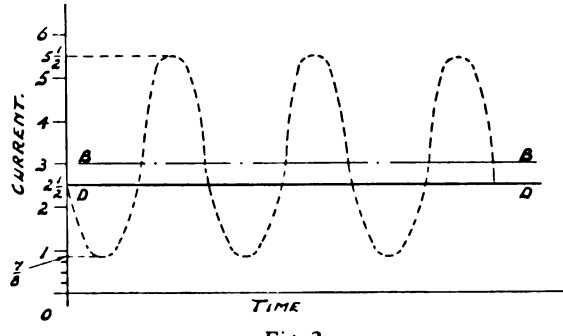

Fig. 3.

current passing through the telephones when the oscillatory voltage is applied across the crystal.

But we have already increased the *normal* value of the current passing through the telephones to the value of 2½, as shown by

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the line DD, Fig. 3, this being the current which will pass through the crystal and telephones when the initial voltage of $2\frac{1}{4}$ volts is applied to bring it up to the point B, Fig. 1.

The strength of the sound produced in the telephones will be proportional, not to the total current passing through the telephones, but to the difference between the current passing through them when no oscillations are being received and the current passing through them when the oscillations are being received.

When the crystal was adjusted to the point A, this difference in current was the difference between 1 and $2\frac{1}{4}$, so that the strength of the sound was proportional to $1\frac{1}{4}$, but when the crystal is adjusted to the point B, the strength of the sound will be proportional to the difference between $2\frac{1}{2}$ and 3, which is only $\frac{1}{2}$.

64. Tuning a Receiver.—We will suppose that our receiver is of the two circuit type, that is to say, that it has a primary circuit and a secondary circuit, both of which must be in tune with the wave-length it is desired to receive. The only means we have of telling whether the receiver is in tune is by the strength of the signals in the telephones. If either circuit of the receiver is out of tune, the signals are weakened, so that provided we have a variable inductance or condenser in each circuit, and **provided we can hear at least weak signals in the telephones,** it is a simple matter to tune up the receiver by listening to the strength of the signals and adjusting first one circuit and then the other circuit, until the sound is at its loudest.

If, however, we are so much out of tune to begin with that the signals are inaudible, the difficulty of tuning up is increased enormously.

In the case of a single circuit receiver, the difficulty is not so great, for we have only one circuit to adjust, and therefore we can vary it slowly from its maximum wave-length to its minimum wave-length, and consequently we are bound to pass the point where the receiver is in tune with and therefore will respond to the signals, provided, of course, those signals are within the range of wave-length of the receiver.

In the case of a two circuit receiver, however, if signals are inaudible to begin with, we have no means of telling which circuit is out of tune or when the two circuits are in tune with each other.

If, however, we know the wave-length of the signals we wish to receive, and we have an instrument close to our receiver which can be made to emit a similar wave-length, the process of tuning up becomes quite simple.

Such an instrument is called a tuning buzzer.

Since our detector and telephones are actuated by the secondary circuit of the receiver, we should first cause the tuning buzzer to induce waves into the secondary circuit only, and we should then adjust this circuit until the buzzer signals in the telephones are at their loudest.

Having accomplished this, we should next move the tuning buzzer to a point remote from the secondary circuit, but close to some part of the primary, or aerial circuit, so that no oscillations can be induced from it directly into the secondary circuit, but only through the primary circuit.

Now if the primary circuit is very much out of tune with the wave-length emitted by the tuning buzzer, it will not respond to the oscillations, and therefore no oscillations will be induced in the secondary circuit, but if we vary the wave-length of the primary circuit, we shall reach a point when it is in tune with the wave emitted by the tuning buzzer. Oscillations will then be induced in the primary circuit, which will in turn induce oscillations in the secondary circuit, as the secondary circuit has already been tuned to the same wave-length. Thus when by varying the adjustment of the primary circuit we reach a point when the signals in the telephones are again at their loudest, we know that we have reached the point when the primary circuit is in tune with the tuning buzzer, and therefore both circuits are in tune with the wave-length emitted by the tuning buzzer.

65. The Tuning Buzzer.—The essentials of a tuning buzzer are, therefore: (1) that it can be caused to emit feeble oscillations, and (2) that the length of these oscillations can be adjusted to any pre-determined value.

To accomplish these *desiderata*, the tuning buzzer has two circuits; firstly, an oscillating circuit, consisting of an inductance coil with an adjustable condenser, and,

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secondly, a generating circuit by which the oscillating circuit is excited.

The construction of the oscillating circuit of a tuning buzzer is identical with that of the wave-meter, which was described in the October number of the WIRELESS WORLD. It consists of a fixed inductance coil connected in series with an adjustable condenser, the latter being provided with a scale and pointer by means of which the value of the wave-length to which that circuit is adjusted is indicated.

There are several ways by which this circuit can be excited. The one most commonly used is shown diagramatically in its simplest form in Figure 4, where L is the inductance coil, C the condenser forming the oscillatory circuit, and where B is a battery connected across the inductance coil through the contact S. If the contact, S, is depressed, thus completing the circuit from the battery through the inductance

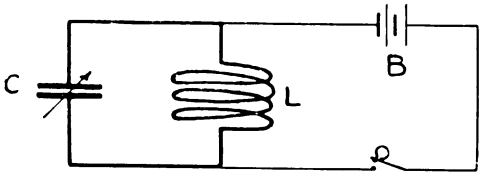

Fig. 4.

coil, a continuous current will flow through this coil. If this circuit be broken by releasing the contact, the current will be instantaneously interrupted.

As already described in the May number of the WIRELESS WORLD, the property of inductance is similar to the mechanical property of momentum, and, therefore, when the current is instantaneously interrupted, the energy due to its momentum is expended in the oscillating circuit of which this inductance forms a part. The result is practically to give this circuit a kick, causing it to oscillate to its own natural frequency; thus every time the battery circuit is made and broken, we produce a group of oscillations in the oscillatory circuit corresponding to the wave-length to which that circuit is adjusted.

If a battery of only two or three volts be used and the inductance included in the battery circuit be a reasonable amount, the oscillations set up will be sufficiently strong to affect our receiver circuit.

This, however, is not quite sufficient, since each group of waves will only give a single click in the telephones. Some automatic arrangement must be used to rapidly make and break the circuit in order to

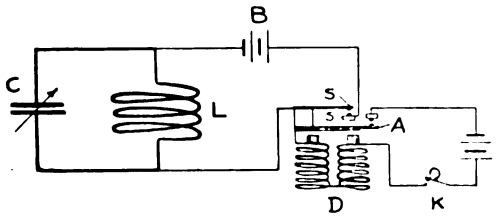

Fig. 5.

produce a continuous buzz or note in the telephones to facilitate the tuning up of the receiver, it being very much easier to distinguish when a buzz or note reaches its maximum strength than if only a number of single clicks were audible.

One method by which this rapid making and breaking of the circuit can be accomplished is shown diagramatically in Fig. 5, where the battery circuit, B, through the inductance, L, is made through a pair of contacts, SS, one of which is mechanically connected to the armature, A, of an ordinary electric buzzer, D, so that when this armature vibrates it causes the extra pair of contacts, SS, to alternately make and break the battery circuit through the inductance L.

In this case two batteries are required, one for working the buzzer and the other for the inductance circuit.

The Canadian Government has been notified by a wireless dispatch, sent by the steamship *Alcazar*, from Hudson Bay, of the wreck of the steamship *Cearense*, which sailed from Halifax on August 30th for Port Nelson. The wreck occurred 14 miles from Root Creek. All on board were saved. The vessel had a cargo of 2,484 tons of bituminous coal, 336,000 feet of lumber, and part of the materials necessary for the installation of the wireless station at Port Nelson.

The *Journal Officiel* of November 7th states that of the loan of 90,000,000 frs. contracted by the Indo-Chinese Government on December 26th, 1912, a sum of 596,800 frs. has now been allocated for the construction of a wireless telegraph station at Saigon.

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Amateur Regulations in U.S.A.

A NEW form has been issued in the United States respecting amateur licences. The form differs but little from its predecessor, except that in the first paragraph the words, "*receiving for pleasure* radiograms or signals and of *transmitting for pleasure* radiograms or signals," etc., have been replaced by "of transmitting private radiograms or signals," etc.

The elimination of the words "for pleasure" will be welcomed by all serious-minded experimenters, and the elimination of "for receiving" comes about as a matter of course, as the law does not require that receiving apparatus be licensed.

Below we give a copy of the new form.

Form 765 Number

LICENCE FOR .....AMATEUR RADIO STATION
(General or restricted.)

DEPARTMENT OF COMMERCE.

BUREAU OF NAVIGATION (RADIO SERVICE).

1. PURSUANT to the act to regulate radio communication, approved August 13th, 1912, ..., a citizen of the State of ....., having applied therefor, is hereby granted by the Secretary of Commerce, for a period of ..... year, on and subject to the restrictions and conditions hereinafter stated and revocable for cause by him, this License to use or operate the apparatus for radio communication (identified in the Schedule hereinafter) for the purpose of transmitting private radiograms or signals, notwithstanding the effect thereof extends beyond the jurisdiction of the State or Territory in which the said station is located: Provided, that no interference other than may result under the restrictions contained in this License shall be caused with the radio communication of stations of the Government of the United States or licensed stations.

2. The use or operation of apparatus for radio communication pursuant to this License shall be subject also to the articles and regulations established by the International Radiotelegraphic Convention, ratified by the Senate of the United States and caused to be made public by the President, and shall be subject also to such regulations as may be established from time to time by authority of subsequent acts and treaties of the United States.

3. The apparatus shall at all times while in use and operation be in charge of a person or persons licensed for the purpose by the Secretary of Commerce, and the operator of the apparatus shall not wilfully or maliciously interfere with any other radio communication.

4. The station shall give absolute priority to signals or radiograms relating to ships in distress; shall cease all sending on hearing a distress signal; and shall refrain from sending until all the signals or radiograms relating thereto are completed.

5. The station shall use the minimum amount of energy necessary to carry out any communication desired, and the transformer input shall not exceed $\frac{\text{one}}{\text{one-half}}$ kilowatt.*

6. The station shall not use a transmitting wave-length exceeding 200 metres.

7. The station shall not use a transmitter during the first 15 minutes of each hour, local standard time, whenever the Secretary of Commerce by notice in writing shall require it to observe a division of the time, pursuant to the Twelfth Regulation of the Act of August 13, 1912.

8. The President of the United States in time of war or public peril or disaster is authorised by law to close the station and cause the removal therefrom of all radio apparatus, or may authorise the use or control of the station or apparatus by any Department of the Government upon just compensation to the owners.

9. The Secretary of Commerce and Collectors of Customs or other officers of the Government authorised by him may at all reasonable times enter upon the station for the purpose of inspecting and may inspect any apparatus for radio communication of such station and the operation and operators of such apparatus.

10. The apparatus shall not be altered or modified in respect of any of the particulars mentioned in the following Schedule except with the approval of a radio inspector, or other duly authorised officer of the Government.

SCHEDULE OF STATION AND APPARATUS.

Name of owner .....
Age .....
Location: State ..... ; County .....
City or town ..... ; Street..... ; No.....
Official call.....
Name of naval or military station, if within 5 nautical miles .....
Power: Transformer input .....; W.†
Antenna: Type (T ⊓, fan, umbrella, etc.) .....
.....
Height..... .....
(Above ground)
Horizontal length .....
Wires: Number in vertical part ..... ;
In horizontal part.....
The normal sending and receiving wave-length shall be ..... metres
(Not exceeding 200)
and the station is authorised to use the following additional wave-lengths, not exceeding 200 metres:
.....metres ..... metres.

Satisfactory proof has been furnished that the station was actually operating August 13th, 1912.

This License expires on .....191 .

* Strike out "one" if the station be within 5 nautical miles of a naval or military station; otherwise strike out "one-half."

† Not to exceed 1,000; or if the station be within 5 nautical miles of a naval or military station, not to exceed 500.

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Practical Hints for Amateurs

Designing a Station

By F. WALFORD PERRY

THE station described in this article is in South London, all the apparatus, except the head phones, being home-made, good working results having been obtained.]

There are two aerials, both of the cage or "sausage" type; by means of switches either or both may be connected up to the instruments.

The larger aerial is an inverted "L" suspended between two masts 150 feet apart, the mast at the free end being 80 feet high and that at the lead-in end 60 feet, giving a total length of aerial of 220 feet.

The wires, of 16 gauge aluminium, are six in number, and are spaced 2 feet apart on 5-feet wooden hoops, which were made by dissecting an ordinary wooden hoop and joining the sections end to end, giving a light hoop of one thickness of wood.

Aluminium was used for lightness, but in other respects it is unsatisfactory and copper should be used if lightness is not the chief essential.

The second aerial is similar, but is much lower, being gracefully draped over the house and trees.

Two hundred volts alternating current from the house mains is the source of power for the transmitting gear—this is stepped up to 7,000-8,000 volts by means of an oil insulated closed core transformer.

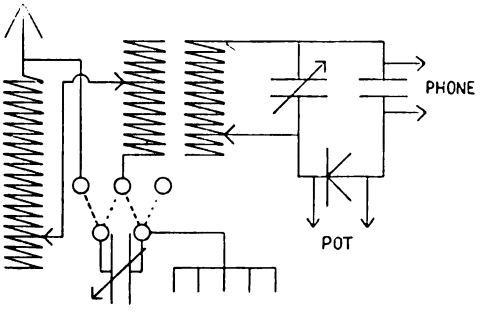

Fig. 1.

The high-tension current charges a ·02 mfd. oil immersed condenser, which is divided into two parts; these can be used in series or parallel, according to the wave desired.

The condenser circuit is completed by one-turn primary of an inductively-coupled jigger, a spark gap enclosed in asbestos-lined box for silence, and a variable sliding inductance.

Tappings are provided on the secondary of the jigger, which is wound with eight turns of 3-20 cable on a 9-inch square frame.

The connections of the transmitting gear are those of the Marconi 1½ k.w. ship set, and the waves emitted are 200 and 400 metres, the latter being the normal.

A rotary spark gap is provided, which gives a spark frequency of 250-300 per second. It will be noticed at the top of Fig. 3.

A lamp shunted across a few feet of the earth wire, and a hot wire ammeter in series, complete this part of the station.

Three complete sets of receiving apparatus are fitted; the one shown on the left of Fig. 2 is mainly used and calls for no special comment beyond that the connections shown in Fig. 1 have been used and found to be simple, and to admit of fair tuning by means of the condenser across the secondary.

The set seen on the left of Fig. 3 has been called the "cheese-box." The inductances are wound on 15 and 13-inch drums, the primary being 18 D.C.C. and the secondary 24 D.C.C.; it is well adapted for long waves and gives slightly better results than the first set on all waves longer than ship ones.

The third set uses a magnetic detector, which is connected to an earth arrester

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gap through a simple form of tuner shown in Fig. 2. It is less sensitive than the Zincite-Bornite detector used in the other sets, but has been found equal to the ordinary ship "maggie."

On the larger aerial the best transmitting results have been good signals at a station in Essex 55 miles distant, and No. 5 size signals on a ship (magnetic detector) 33 miles away. Stations as far distant as Malta S.D. are heard, and under favourable conditions, and at night, most European coast stations within 800 miles can be heard.

Fig. 2.

It is reported in the Press that the trials and experiments with hydro-aeroplanes which have recently taken place at Cromarty have induced the Admiralty to organise an even more important series of experiments with a view of determining how far wireless telegraphy will extend and emphasise the value of aircraft in naval warfare.

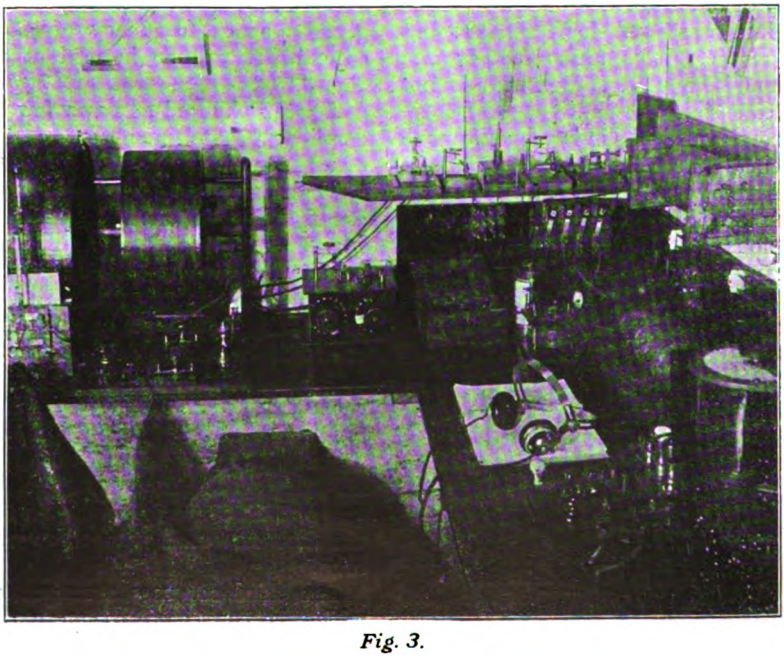

Fig. 3.

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AMATEUR NOTES.

A GENERAL meeting of the Wireless Society of London was held last November, when the rules of the Society, which had been drawn up by a committee, were unanimously passed. Mr. Russell Clarke said it was proposed to have first-class standardised apparatus in the Society's laboratory, and about £70 worth of apparatus had already been promised by members. To make this Society self-supporting and flourishing the original subscription was fixed at one guinea for metropolitan members and associate members, 10s. 6d. for country and foreign members, and 10s. 6d. entrance fee. The President, Mr. Campbell Swinton, gave a short address on the object and progress of the Society, and called on Dr. W. H. Eccles to outline the research work initiated by the Radio-Telegraphic Committee of the British Association and to indicate how members of the Society could help in this work.

* * *

Dr. Eccles said that the committee recognised its duty to be the undertaking of work which could not be performed by individual experimenters. Discharges from the atmosphere in the immediate neighbourhood of a station (causing sparking in the aerial, or permitting a vacuum tube to be lighted) were called "statics" or "atmospherics." Disturbances arriving from a long distance were termed "strays," and the British Association had decided to investigate these natural electric waves, which travelled over a large part of the earth. About 70 per cent. of strays received at stations in the North and South of England could be traced and identified, but to trace them to their source —perhaps thousands of miles away— required a world-wide network of observers. Already the British Association was prepared to start work with 200 or 300 observers in British and foreign colonies, the United States, and ships in various seas. By the examination of records received it was hoped to determine the laws and nature of "strays," and also (since the same set of observers would serve) to determine the influence of meteorological conditions on long distance transmission. The committee was preparing official forms, so that all information might be collected on a uniform plan; specimen copies of this form would soon be available to members, but, for the present, the committee would only accept official assistance from, say, a dozen members of the Society scattered up and down the country. There were, however, many unofficial ways in which members could be of immense assistance to the committee. For example, any member passing a directional aerial should observe the direction from which disturbance proceeds during X-storms. There was much to be done, too, in the way of recording sunset and sunrise variations in the strength of signals received from, say, Coltano. Hitherto the difficulty had been to measure strengths of signals, but accuracy could be gained by practice, and the calibrating laboratory of the Society would doubtless prove invaluable. Two members working simultaneously on long and short aerials, or on two differently tuned receiving sets in the same aerial, should record the frequency and strength of the strays received; these would not be the same in each case. If members would work along these and similar lines, and if a subcommittee of the Society would sift reports before transmitting them to the B.A. Committee, the latter would be helped enormously and this country would become the centre of such research.

* * *

The second exhibition of the Derby Wireless Club was held on December 3rd at the Mechanics' Institute. The room was crowded to excess from 4 until 11 p.m., much to the benefit of the Society's exchequer. Permission had been obtained from the Post Office to erect a temporary aerial, and many visitors availed themselves of the opportunity of hearing wireless signals for the first time. Sir Henry Norman, M.P., the President of the Club, lent a number of instruments, and Repton School also exhibited some instruments, while among other exhibits were a "Brown Relay" and mirror galvanometer for wireless. There was also an automatic transmitter at work throughout the evening, and another transmitter, which required neither mains, accumulators nor batteries. Much excellently designed and ingenious apparatus was shown—far too many things to note in detail. The District Society of Model Engineers co-operated and displayed a number of models of all kinds—the largest being a 6-ft. steamship. The

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whole of the arrangements reflected very great credit to the assiduity and zeal of Mr. A. Trevelyan Lee, the hon. secretary.

* * *

Mr. Hyde, of Seacombe, presided at the November meeting of the Liverpool and District Amateur Wireless Association. As usual there was apparatus brought forward by several of the members for inspection and discussion. This was followed by a short lecture by a member on "Terrestrial Magnetism." The lecturer dealt with the position of the magnetic poles of the earth as compared with the geographical north and south poles and with the questions of variation or declination, inclination, and intensity at any place, secular variations, annual variations, diurnal variations, and irregular variations. The subject of inclination or dip was fully gone into and illustrated by experiments, and the lecturer concluded by advising members not to overlook the question of "Terrestrial Magnetism," as he was of opinion that it was a factor in the matter of wireless telegraphy.

* * *

The December meeting of the Association was presided over by Mr. G. Irvine. A member described the construction of an apparatus he had designed. A single telephone wire with an earth return is used as a wireless aerial, and the "far" end insulated from earth and phone when used for wireless purposes. The ordinary telephone circuit is connected when wireless sending or receiving had been completed; the connections at the far end are controlled from the opposite end at which the wireless set is situated, without the use of any additional line wires. The subject of the best design and connections for umbrella aerials was under consideration, also the question of the most suitable wires for aerial use.

* * *

At a meeting of the Birmingham Wireless Association presided over by Mr. J. J. Shaw, Mr. E. E. Robinson, who is associated with Sir Oliver Lodge in his practical and experimental work, delivered an interesting address. He dealt with ordinary vibrating bodies, elasticity and inertia, then passed on to some early experiments. Mr. Robinson's lecture, which was well illustrated by lantern slides and which included a number of interesting experiments, was thoroughly enjoyed by a large attendance of members. The meeting of the Association held on December 5th marked a novel departure, when Mr. Shaw lectured on the Seismograph and Seismology.

* * *

In the October number of THE WIRELESS WORLD it was announced that a number of students of wireless telegraphy in Edinburgh had decided to form a wireless club, to be called "The Edinburgh Wireless Club." Since then the labours of the committee have not been fruitless, despite the difficulties to be contended with, and which have been successfully overcome. It is the intention of the committee to provide for the erection of a complete wireless installation. As far as possible this will be the work of the members themselves, and so room will be given for instruction in the principles underlying wireless telegraphy. Mr. W. D. Owen, the president, has consented to give all the help and advice necessary to make this particular part of the club's work a complete success.

* * *

Nor is the theoretical side of wireless telegraphy neglected. The reading of papers on various matters connected with radio-telegraphy by members and others will help to broaden the outlook of members with regard to the comprehensiveness of the subject. Although formed by prospective operators in wireless telegraphy, it is the intention of the club to welcome into membership all amateurs who take an interest in wireless telegraphy. The secretary, George Scott Creighton, will be pleased to hear from any one in the Edinburgh district who has not already communicated with him.

* * *

At the annual meeting of the Gateshead and District Scouts' Association the hon. secretary, Mr. R. B. Hindmarsh, reported that a wireless telegraphy section had been formed—the first of its kind in the North—possessing two complete stations which were licensed by the Postmaster-General.

* * *

At the opening meeting of the Manchester and District Wireless Club, held at 15, Abbey Hey Lane, near Openshaw, Manchester, the following committee, etc., were elected:—

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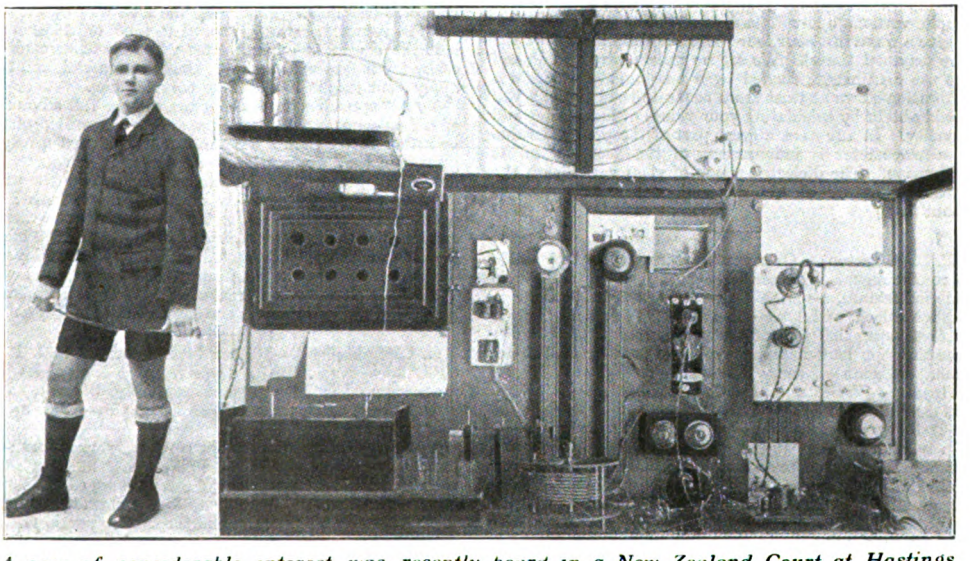
C. Heap (Secretary), S. Waterhouse (Treasurer), F. Goddard, J. D. Walker and R. J. Richardson. The objects of the club were fully explained by the chairman, and its policy discussed. The committee were authorised to negotiate for the acquisition of a club-room. All interested and wishing to join this club should communicate with the Secretary at the above address.

* * *

An example of the unrelenting measures adopted to suppress amateurs abroad is furnished by a case which recently occurred in the Hamburg Police Court. The chaplain of the English Church at Hamburg and Mr. Olson, an official of the Seamen's Home, were fined six shillings for working an unauthorised wireless installation. It was shown that wireless apparatus had been set up on the spire of the English Church, and was used to communicate with incoming British vessels, and it was also alleged that they had tapped messages sent out by the Imperial Wireless Station at Nordreich. Their original impression that it was an outrageous case of espionage was abandoned by the authorities, and the Public Prosecutor only asked for the infliction of a fine. The judge concurred with the view that the defendants had offended in ignorance and accordingly imposed only a small fine.

* * *

We have received a communication from a reader in a small inland town in New Zealand—Gore—which though a hundred miles from the nearest port is regularly supplied with copies of THE WIRELESS WORLD. Judging from his letter the lot of the amateur in New Zealand is not altogether a happy one. The penalty for erecting an aerial for the transmission or the reception of wireless messages is £500, in addition to which all the apparatus is liable to seizure. Notwithstanding this there are a number of enthusiastic amateur experimenters in wireless telegraphy who are making strong efforts to have their existence recognised by the authorities. Our correspondent is anxious to know the position with regard to amateurs in this country and he desires to correspond with amateur experimenters in this country. We shall be glad to forward his name and address to anyone who would like to get in touch with him. This communication from the Antipodes is another welcome indication of the influence of THE WIRELESS WORLD in bringing amateurs throughout the world in touch with one another.



A case of considerable interest was recently heard in a New Zealand Court at Hastings (Hawke's Bay), when Eric H. Battershill (shown in the illustration on the left) was charged with having established a plant for the purpose of receiving communications by wireless telegraphy without having obtained the consent of the Postmaster-General of New Zealand. Defendant promised not to use the apparatus again, and was convicted and ordered to come up for sentence when called upon.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

J. H. (Ipswich).—With reference to your repeated advice "Use a Wavemeter," could you give the following advice to help readers to make one: (1) What is the best ratio of C to L? (2) Could you give particulars of an inductance coil which would be suitable for λ up to 600 m and state its approximate L? (3) With air dielectric for condenser $C = \frac{A}{4\pi d}$. Would the above information be near enough for amateurs who cannot afford a calibrated instrument? (4) For use in making a fixed wavemeter could you give the dielectric values for glass and mica for frequencies corresponding to 100, 200, 300, 400, 500 600 λ?

Answer.—Ratio is not important for a wavemeter. Using a carborundum crystal—by far the most suitable for the purpose—an excellent wavemeter may be made with a capacity of ·001 microfarad (maximum value), which, of course, requires an inductance of rather over 100 microhenries to give a range up to 600 metres. As it is advisable to arrange things so as to be able to get on either side of the tuning point even for the maximum wave of the range, the inductance should be made rather larger than this; you might start with 35 turns of No. 22 wire on a 4-inch diameter former.

Instead of calculating your values of inductance and capacity and then combining the results to calibrate your wavemeter, it will be best for you to calibrate it by comparison with standard fixed circuits. The simplest forms of standard circuits, for your purposes, would be a series of simple vertical one-wire aerials; taking each of these to give a wave just over four times the actual length of the wire (say, 4·1 times). We see no reason why you should not use a thin wire carried by a box kite, and obtain a calibration-curve at least more accurate than the one you would obtain by calculating your values of inductance and capacity. In any case, a great part of the practical value of a wavemeter is independent of the accuracy of its calibration. The dielectric value of glass varies with the particular nature of the material, but a fair value is about 7.

P. B. (Brighton).—Over what distance will it be possible to receive signals with the following apparatus: A single slide inductance, a variable condenser, a potentiometer, a single headgear of 1,000 ohms, aerial of 4 line wires, height 75 feet, using 300 feet of aerial wire? Is a transformer necessary for long-distance work and will an additional tuning inductance improve the signals?

Answer.—(1) See replies to G. L. and G. H. D. in May and July numbers (1913).

(2) Do you mean a telephone-transformer or an oscillation transformer—a "jigger"? If the former, you would not need one as your telephones are 1,000 ohms resistance. If the latter, a jigger is always better than a direct-coupled circuit, since such far better "tuning" and selectivity can be obtained. The direct-coupled circuit, however, is at its best in the hands of an amateur, for the following reasons: it is more simple to adjust, and it means only one long inductance; whereas a jigger means that the amateur's short aerial has to be lengthened by a long inductance so as to be in tune with the long waves which most amateurs set out to receive, and in addition the jigger-secondary must comprise a long inductance so as to form, with a small condenser, a circuit which is tuned to the same waves. Hence the direct coupled circuit can compete far more successfully with the jigger in amateur wireless than it could hope to do in commercial wireless; especially as selectivity does not matter much to the amateur who does not mind missing a word now and then from "jamming."

W. A. J. (Colwyn Bay).—Submits a sketch of his aerials and asks if he is working on the right lines. His aerial rods are 3 feet 6 inches long, and he uses 4 aerial wires No. 18 w.g. 12 inches apart.

Answer.—We cannot be sure from your sketches exactly where your instruments are or where your lead-in comes; from the text it would appear to enter at the roof-window (the only one shown), but from the sketch itself it seems to be aiming at some lower entrance. If it comes in at some lower window we should prefer to have a simpler aerial with its free, insulated ends at the roof-mast and its down-lead coming slanting down direct from the 33 feet mast to the instruments. The objection to your plan is that the second part of your aerial is running so close below the top horizontal part, which is always bad. It is like having the go and return leads in an alternating-current circuit close together under the same sheath—which helps to prevent the leads from picking up induced effects. If your down-lead has to come in at the roof-window, we should recommend bringing it in as direct as possible from the roof-mast, the free ends in this case being at the 33-feet mast. But really the best way by far is to try for yourself; surely, too, that kind of thing forms half the charm of experimental wireless. You could so easily try it first with a simple single-wire aerial, and then apply your results to the more complex one.

Your "spreaders" are too short to take full advantage of a four-wire aerial; still, the four wires will probably be rather better than a less number, though not nearly so good as if they were each spaced three feet or so.

We do not quite like the idea of your making the whole of your down-lead of 3-ply rubber-insulated wire; on occasion this plan leads to serious trouble in wet weather; especially if there is sea-water about. One of the effects is that the rubber gets coated with a conducting layer of water, which forms a condenser with the internal wire. We should advise you to make your down-lead similar to the rest of the aerial until it wants to enter the house.

G. L. (Dukinfield).—I have been informed that I can either have my sending set working at a high or low frequency by adjusting the spark-gap and condenser. How is this done, and which is best to employ—high or low frequency?

Answer.—Taken without its context, your informant's remark is rather cryptic. We think that he means that the number of sparks per second can be changed by altering the length of gap and the value of the capacity, which is true. The shorter your gap and the smaller your condenser the more rapid will be your sparks, up to a certain point The best arrangement should be found by experiment, using the readability of the received signals as the test. But your friend should have used the word "spark-frequency," and not "frequency" alone, if this is what he meant; "frequency" by itself nearly always means an alternating or oscillating frequency.

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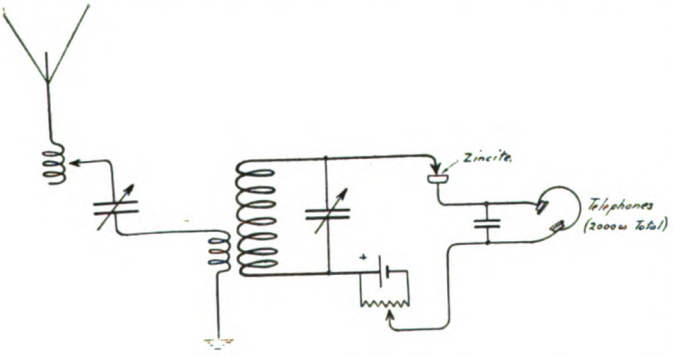
A. G. C. B. (Chelmsford).—Is it possible to connect a buzzer (electric bell with gong removed) to a pair of wireless 'phones, battery and manipulating key, so that when the circuit is closed through the key, the buzzer can be heard by the person who is wearing the 'phones? If so, would you be so good as to explain connections. (2) The best means of arriving at the resistance of a pair of 'phones.

Answer.—(1) There are several good ways of doing this. You can put your battery, manipulating-key, and buzzer all in series with a resistance, and connect your telephones across that resistance; then the varying potential difference at the ends of the resistance will drive small currents through the telephones and give you the signals. By making the resistance a variable one you can regulate the strength of the signals—the smaller the resistance the weaker the signals. The total resistance should not be too great compared with that of the buzzer coils, or it will spoil the action of the buzzer. A resistance variable from 0 to 30 ohms should be suitable. Another way is to wind a few turns of wire round an iron core (say $\frac{1}{4}$ in. diam.), and a much larger number of turns (say 25 times as many) of smaller wire on top of these. Connect the few turns in series with buzzer, battery and key, and the many turns across your telephones; then the interrupted current in your buzzer-circuit will induce suitable currents in the telephones. Signals might be varied in strength by making the iron core to slide inside the two coils.

(2) A Wheatstone Bridge (see any text book of electricity) is the best. If you have a voltmeter of known resistance, you could use it as a small reading ammeter, or rather milliameter, by calculating what current must flow through it to produce a deflection of one subdivision of its scale: then you could put it *in series* with your telephones, and apply such a voltage as to cause a suitable deflection; thus, knowing the applied voltage and the current passed by it through the telephone resistance, plus the known voltmeter resistance, you could find the resistance of the telephones. But really the resistance of telephones is a very poor indication of their value. They are best tested on actual signals.

M. X. X. (Blackburn).—(1) According to Dr. Eccles a "Perikon" detector works best when the zincite is — ve and the difference of potential is 0·45 volts. (2) At the foot of page 373 of the Year-Book of Wireless Telegraphy and Telephony, 1913, are the following words: "If it had been fully recognised that choking coils in the primary circuit could be used for bringing the system into resonance with the frequency of the alternator." How is this explained?



Answer.—(1) Best connections shown in accompanying diagram. (2) In a transmitting set such as is shown in your diagram (which however omits the all-important spark-gap) there are, if we neglect for the moment the aerial circuit, two distinct circuits—the low-frequency and the high-frequency circuits. The condenser comes into both of these. The high-frequency circuit consists of the condenser, the jigger-primary, the spark-gap and the leads joining all these. The low-frequency circuit comprises the condenser, the air-core chokes, the transformer as a whole, the primary choking coil and the alternator armature itself. This circuit would appear to be made up of two separate circuits, the one including the alternator and the transformer-primary, the other including the transformer-secondary and the condenser; but the effect of the transformer is to link these two into one, so that the low-frequency circuits can be treated as one whole. This whole circuit has to be tuned to the frequency of the alternator just as the high-frequency circuit has to be tuned to the frequency of the wave which it is required to transmit; although in the first case the frequency is 40 a second and in the second case it is one and a half millions a second (since you are using a 200 metre wave). Thus, just as the high-frequency circuit has to have its capacity and inductance adjusted so that $n = 1/2\pi\sqrt{CL}$, so the low-frequency circuit must have its $N = 1/2\pi T\sqrt{CL}$, the introduction of the extra factor T (the transformation ratio of the transformer) being the difference produced by connecting the condenser to the alternator through the transformer instead of directly. In practice the tuning of this circuit is best done by adjusting the inductance until the resonance obtained causes the maximum spark to occur across the spark-gap.

CALL (S. Wales).—I have recently erected two aerials about a quarter of a mile apart. The one aerial is 300 feet long and 60 feet high at one end and 25 feet at the other. The high end has suspended from it 3 wires, which come down to the instruments. At a point some 6 feet from the vertical wires I have suspended from the aerial and insulated from it an umbrella aerial composed of 6 wires 75 feet long. The large aerial is for long distance receiving and the umbrella aerial I intend using to communicate with my house a quarter of a mile distant, where I have another aerial, 35 feet high at high end, coming down 50 feet to a 20-foot pole, and from there back to the kitchen window, making a V aerial. I want to transmit only on the umbrella aerial, at 30 watts on 200 metre wave length, and simply receive at my house, but my difficulty is how to arrange a call signal. I have in hand a coherer and bell. Should I be able to operate a coherer over this distance and make it selective by tuning, so that it would not be operated by outside stations? Would there be any advantage in making the call on the large aerial at the transmitting end?

Answer.—You should be able to get a coherer-receiver to work well over such a distance with very small powers, say, an ignition coil sparking a plain aerial. It will be practically impossible to make the receiver so selective by tuning that it will only respond to your call; you had better devise a special relay with some kind of dash-pot arrangement so that it will only respond to a long dash—a piston working in oil, for instance. On the whole, we think you had better stick to your plan of using the umbrella aerial for transmitting your call, for although your longer aerial has a better average height, you would have to reduce its wave-length by a condenser in series in order to use your 200 metre wave, for which the receiving aerial at your house is suitable. If you have any trouble, however, in getting strong enough signals, you might try the big aerial. And, by the way, you had better keep the big aerial carefully insulated while you are sending on your umbrella close at hand, or you will be losing energy by inducing in the big aerial.

(A number of replies have been unavoidably held over owing to pressure upon our pages.)

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The Central Telegraph Office

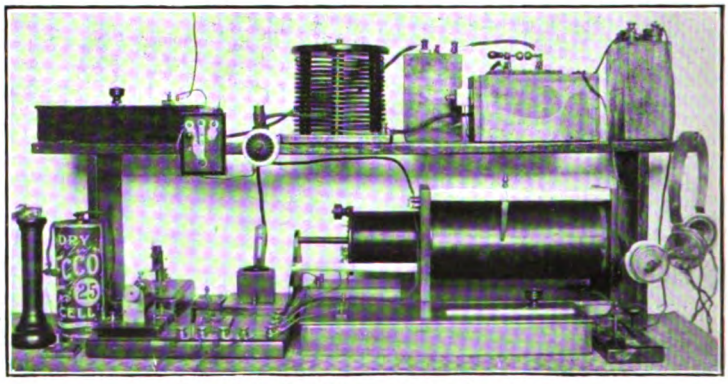
EXPERIMENTAL WIRELESS SOCIETY

IN a Department such as the Central Telegraph Office, consisting of some thousands of operators, it is not surprising to find many flourishing societies. Although probably the smallest society in that office, the "Experimental Wireless Society" is certainly not excelled in the enthusiasm of its members for its tenets.

Once a telegraphist always a telegraphist, and telegraph operators, whether on or off duty, are always drawn to the fascinating "dot and dash"; but the members of this society go a step farther, and after busy days in the operating galleries they are to be found surrounded by a very definite atmosphere of "Morse."

The members are not in receipt of stupendous salaries, and in order to possess a wireless installation much originality and constructional ability are called for. In almost every case the apparatus used is entirely home-made, and when one remembers that a workshop, or even a well-stocked tool chest, is out of the question, it will be readily understood that many hours of labour and great perseverance have been necessary to produce the really beautiful instruments it has been the writer's privilege to inspect. The apparatus is, of course, designed to suit the individual local conditions, and the installations have to be confined to the back gardens and any available space within the members' houses.

The erection of the "aerial" is perhaps the most difficult matter to overcome, and to manœuvre a 40 ft. scaffold pole into a garden 30 ft. long, with only the domestic clothes line for tackle, is not a task to be undertaken by frivolous persons. This particular aerial is only 28 ft. in length, but it has, nevertheless, been the means by which messages have been received from most of the British and Continental stations. The apparatus connected with it had to be specially designed and constructed, as, of course, such a small length of aerial is quite unusual. One fortunate member possesses an aerial of a length greater than that of many ship installations! Another, greatly daring, screwed a number of gas-pipes together, and forced the standard up the chimney, terminating his aerial at the top of it. Modern suburban houses are not, however, built for students with such proclivities, and it is not to be wondered at that in one case the local builder had to be called in to reset a chimney that had become dislodged in consequence of the strain of the aerial anchored to it. One member sends and receives to a colleague a mile or two away, but he has a transmitting range of five to six miles. All the installations are eminently successful, and time signals and meteorological messages are received from Continental stations, as well as ordinary messages exchanged between ships and coast stations. The efforts of learners at the several wireless schools afford an extensive field for investigation into mysterious "codes."



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Personal Items.

The marriage took place at the Parish Church, Waenfawr, on November 19th, of Mr. Harold B. F. Childs, chief engineer of the Marconi Station at Cefndu and Miss Enid Mary Williams, only daughter of the Rev. R. A. Williams. The presents included one from Mr. Marconi, and another from the engineering staff of workmen at the Cefndu Wireless Station.

Marconi Orchestral Society.

The first concert of the newly-formed Marconi Orchestral Society was held at Marconi House, on November 27th, and was an unqualified success. With one or two exceptions the items were contributed by members of the society, and all of them, vocal and orchestral, reached so high a level of excellence that the conductor, Mr. H. F. White, and the members of the society well merited the unstinted praise that was bestowed upon them. During the interval the swimming challenge cup and medals, presented by Capt. H. Riall Sankey, and the lawn tennis challenge cup, presented by Mr. D. Willock, were awarded to the successful competitors.

It was a source of great satisfaction to the organisers of the concert and to the large audience to have with them the Managing Director of the Marconi Company, Mr. Godfrey C. Isaacs. After handing out the prizes Mr. Isaacs congratulated the Marconi Musical Society on the rapid development it had made within a very short time. He presented the society with a cheque for 25 guineas, and expressed the hope that next time a concert was held they would give him timely notice of it so that not only he but some members of his family and friends might have an opportunity of attending. He also intimated that the directors of the Marconi Company would offer a cup for competition between the Marconi House and Chelmsford orchestras. Finally, Mr. Isaacs referred to the proposal of the staff to hold a dinner, and he asked the staff instead to accept an invitation from the directors of the company to dine with them.

This dinner was held on Saturday, December 20th, at the Criterion Restaurant, London, Mr. G. Marconi presiding. About four hundred members of the staff, including a number of visitors from the works at Chelmsford, accepted the hospitality of the directors, and the enjoyment of the evening was enhanced by the rendering of a high-class musical programme. Altogether, the gathering was a notable one, and the tenor of the few speeches made during the evening clearly evinced the interest of the directors of the company in the welfare of the staff of the Marconi Company.

The Marconi Athletic Club.

The Football Section of the above club is at present being well supported by its members, and the results of the matches played during the present month have been very encouraging. The first eleven continue to do well in the Western Suburban Alliance, Division 1, having obtained the maximum number of points from the four games played. After a most disastrous start the second eleven have now got together a very good side. Of the last four matches played, two have been won, one drawn, and one lost.

Patent Record.

The following patents have been applied for since we closed for press with the December number of this magazine :

26402. November 18th. William T. Ditcham. Radio-telephony.

26833. November 21. Peder Olaf Pedersen and Valdemar Poulsen. Multiple arrangement of H.F. electric current generators.

26934. November 22nd. Soc. Marius Latour et Cie. Transformation of the frequency of H.F. alternating currents for wireless telegraphy and telephony.

27175. November 25th. William J. Mellersh Jackson (Sig. Ges. M.B.H., Germany). Radio-telegraph station.

27183. November 25th. B.T.H. Co., Ltd. (Allegemaine Elt. Ges., Germany). Methods of tuning alternating current circuits.

27329. November 27th. R. C. Galletti. Production of electric impulsive discharge.

27480. November 28th. Marconi's Wireless Tel. Co., Ltd., and H. J. Round. Receivers for wireless telegraphy.

28183. December 6th. André Blondel. Method of determining the location of radio-telegraphic lighthouses and the like.

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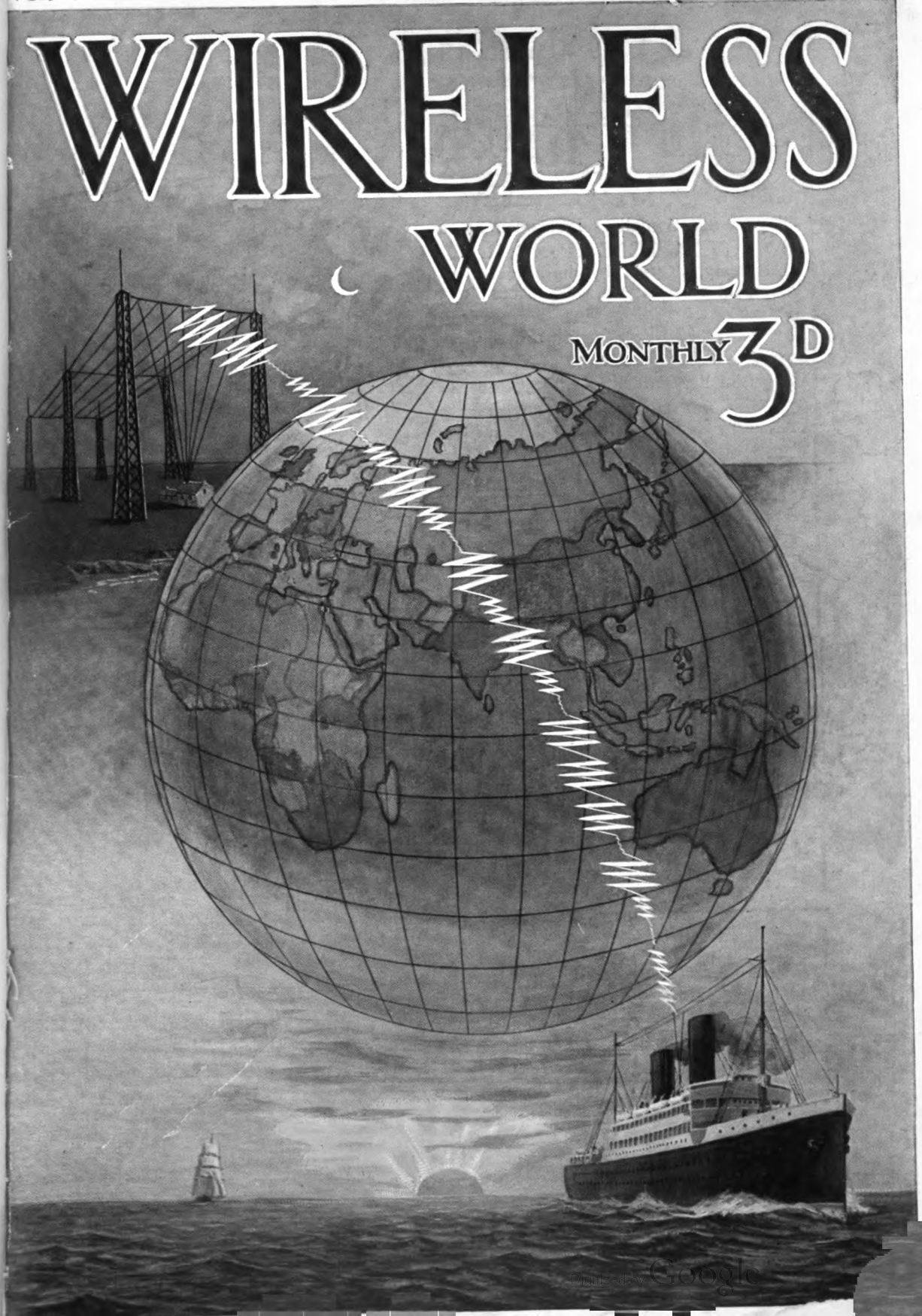

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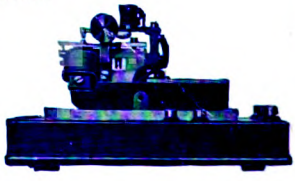

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The Editor will be pleased to receive contributions; and illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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The MARCONIGRAPH

Vol. 1.—No. 11. (New Series) February, 1914. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

Paths of Progress

THE announcement that the Postmaster-General has consented to a licence being granted to Marconi's Poldhu station for the purpose of conducting a commercial wireless telegraph service between England and Spain is itself of sufficient importance to mark the past month as an epoch-making one in the annals of wireless telegraphy. But it is not the only noteworthy event; for in the announcement that the next British Antarctic Expedition will be equipped with a wireless telegraph station, and in the record of the part which wireless telegraphy has played in saving life and shipping, the New Year may truly be said to have opened with abundant evidence of progress and of the realisation of mankind's debt to Mr. Marconi.

If the opening of a direct Anglo-Spanish Commercial Wireless Telegraph Service does not fire the public imagination to the same extent as does the more spectacular and dramatic incidents already referred to, it is probably due to the fact that the public are already familiar with Mr. Marconi's remarkable long-distance achievements, of which the working of a regular Transatlantic service is only one example. But there is no gainsaying the importance of this new development, which is calculated to offer many far-reaching benefits. The arrangements are in hand to open this service to the public, and we hope to publish full particulars in our next issue.

If this development illustrates the great advantages which Mr. Marconi's scientific invention has conferred upon the commercial world, the use which is to be made of wireless telegraphy in the next Polar expedition shows what advantages are offered in other fields of human activity. As we point out in an article which appears elsewhere in this issue, wireless has been used by Dr. Mawson in the expedition in which he is at present engaged. In October next Sir Ernest Shackleton will make a start from Buenos Aires with the object of crossing the Antarctic Continent from the Weddell Sea to the Ross Sea, a distance of 1,700 miles, passing the Pole on the way and settling, in particular, two moot geographical points with regard to the extent of the Great Polar plateau and the Victoria chain of mountains. With him he will take a wireless telegraph station having a range of about 500 miles. As far as we at present understand, it is not Sir Ernest's intention to use wireless telegraphy on his ships, but there is no doubt it will be a valuable resource to the sledge party in enabling them to communicate, if necessary, with their base. If there is a breakdown, or if he has to return, he will thus be able to get a party sent out to meet him.

It is unnecessary to make more than a passing mention here of the part which wireless telegraphy has played in the saving of life during the storms of the past month. One striking example stands out, however. It is that of the R.M.S. *Cobequid*, which went ashore on the Trinity Ledges in the Bay of Fundy. If the vessel had been unable to send out its appeals for help far and wide the fate of all on board would have been inevitable, for, even as it was, it was not easy to find the wreck in the midst of the wintry storm in a bay where the rise and fall of the tide is greater, perhaps, than in any other part of the world, amounting to between 60 and 70 feet. But for wireless it is undeniable that the situation would have been a hopeless one.

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SENOR A. MARIA DA SILVA

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Personalities in the Wireless World

SEÑOR A. MARIA DA SILVA

Administrator-General of Posts and Telegraphs in Portugal.

ENGLISHMEN are, as a whole, liberal-minded, and this characteristic shines out most conspicuously in the diplomatic relationships of England with other nations. England has throughout her national existence been noted for her generous attitude and her willingness to give assistance to all those who may have sought her aid, even though they hold opinions contrary to her own accepted theories. Many a time her disinterested action has, by the caprice of fate, proved of no small advantage to herself, a fact which none who are acquainted with the history of this country can deny; and it is just this same spirit of tolerance which is hers to-day that enables her to occupy her high place in the council of the nations. This has recently been evidenced in the diplomacy which distinguished her relationships with the old and new Portugal. She maintains the same friendly attitude towards the new Republic as she did towards the old Monarchy. She can, without prejudice, observe, and is willing to acknowledge, the many advantages in the new régime established in Portugal; but as she extends the right hand of fellowship she makes this reservation—secure in the knowledge that her disinterested motives will be understood —"you must not expect me to give old friends the go-by; nevertheless, you may rely on me that I shall not interfere with your own personal concerns." And it is in this light that Portugal has accepted her friendship and all works smoothly to the world's weal.

And herein is her attitude justified. Her example has been followed by all the great Powers, and Portugal has been allowed to work out her own salvation unimpeded. Government has been enabled to progress without fear of diplomatic difficulties, and already its strenuous endeavours for the advancement of the country are apparent. More particularly is this the case with wireless telegraphy, which, introduced under the old order of things, has been augmented and its system perfected under the new. The man chiefly responsible for this happy state of affairs is Señor Anton Maria da Silva, the Administrator-General of Posts and Telegraphs, the details of whose brilliant career may interest our readers.

Señor Da Silva was born in Lisbon in 1872, and after the usual preparatory schooling in that city entered the Polytechnic in 1891, thence proceeding to a course of study in the School of Mines, in which he applied himself to such advantage that his name was high up in the list of successful candidates in the final examinations. In June, 1895, when he entered service as a conscript he was nominated an engineer in the Mining Corps, and soon became the chief officer of his battalion, while he was promoted to be subaltern engineer of the second class in 1900 and of the first class later. He also became a member of the Association of Civil Engineers, and in the year 1904–5 he acted as director of that society. He is also a member of the Geographical Society, and at one time was secretary to the Section of Engineering and Land Communications, and also to the Section of Geology and Mines, while last year he was President of the Society for the Promotion of Portuguese Interests. He is a clever writer, and was collaborator in a book entitled "Notes on Portugal" which was issued in connection with the National Exhibition at Rio de Janeiro in 1908. In Parliament he is member for the district of Lilses; finally, in 1910 he was nominated Director-General of Posts and Telegraphs, and when the new Republican régime came into force in 1911 he was created Administrator-General of the same section, which position he still holds.

Señor Da Silva represented his country at the International Radio-Telegraph Conference held in London in 1912, and is a well-known and highly-respected figure in the wireless world.

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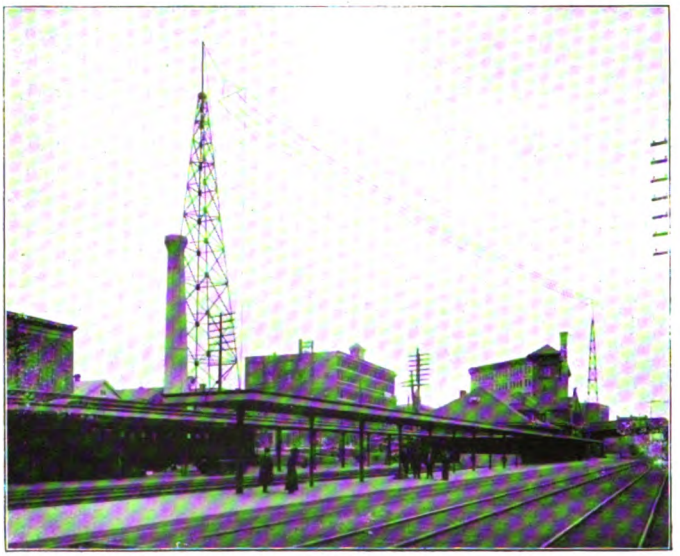
Wireless for Railways

Successful Results of Trials on the Lackawanna Railroad

WHEN wireless telegraphy became a practical, commercial certainty, the equipment of steamships followed as a matter of course, with the result that the sea has been robbed of much of its terror. Has the time arrived when Mr. Marconi's remarkable invention can be applied with equal success to railways? The unqualified triumph recently achieved in the United States of America points to an answer in the affirmative and indicates that we are on the eve of a development which will revolutionise railway travelling and add much to the safety and convenience of travellers.



Towers and Aerial at Binghamton Railway Station.

The management of the Delaware, Lackawanna and Western, or the Lackawanna railroad, as it is generally called, have been experimenting with wireless telegraphy on its passenger trains, and so successful have the experiments been that the prediction is made by an official of the company that "every Lackawanna train will be equipped with wireless within the next six months."

Since the wireless has been such a success on ships at sea, there seems every reason to believe that it can be advantageously adapted to railways. Certain difficult problems arose in connection with this, but they did not awe the officials of the Lackawanna railroad or of the American Marconi Company, who have scored a signal triumph in the work which they have undertaken.

The value of a wireless installation was strikingly illustrated during a test on the Lackawanna railroad train, which left Hoboken at 10.15 on the morning of November 24th last. The conductor of the train, known as the Lackawanna Limited, which was bound for Buffalo, became ill when thirty miles east of Scranton, Pa. Ordinarily it would have been necessary to stop the train and send a telegram asking for a relief conductor to be ready to take charge, or else wait for another conductor when the Scranton station was reached. On this occasion Mr. David Sarnoff, chief inspector of the Marconi Wireless Telegraph Company of America, was operating the wireless apparatus on the Limited train. The Limited was running at a speed of 50 miles per hour, but a wireless message announcing the conductor's illness and asking for a relief was despatched to Scranton. The train arrived in Scranton about half an hour afterwards and another conductor was on the station platform ready to step aboard.

When the Limited left Hoboken it was filled with passengers, and as it continued the

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conductor realised that he would require another coach. It was only necessary for him to notify the man at the wireless apparatus of what he wanted, and a few minutes afterwards a message was sent flashing over the mountains to Scranton, asking for another car to be held in readiness and added to the Limited when it arrived. The car was waiting when the train reached Scranton, and no time was lost.

In charge of the wireless test on the train was Mr. L. B. Foley, Superintendent of Telegraphs for the Lackawanna. He decided to get off at Scranton and return to New York on a train due in the former city two hours after his arrival. Mr. Sarnoff, however, remained on the train to continue the tests, and as the train Mr. Foley had arranged to board—the Eastbound Limited—was due in Binghamton an hour before the arrival of the Lackawanna Limited, the Marconi operator decided to leave for New York on an express at midnight.

While in Scranton, however, Mr. Foley was informed that the Eastbound Limited was an hour behind time. A wireless message was therefore sent to Binghamton from Scranton and thence to Mr. Sarnoff on the Lackawanna Limited, informing him that he could make the connection with the East-bound Limited at Binghamton. In consequence he and Mr. Foley returned to New York on the same train.

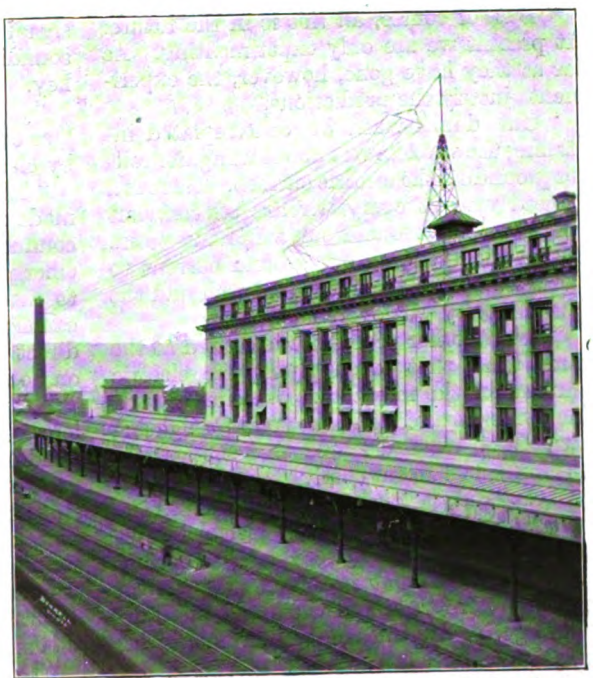
Mr. Foley believes that when all trains have been equipped with wireless the absolute severing of all communication between trains and stations will be done away with. This will mean that disasters like the Dayton flood and the San Francisco earthquake will not cut off communication between the storm-devastated sections and the outside world. Wrecked or derailed trains will be able to notify stations about accidents as soon as they occur and word can be sent to the nearest point outside the storm centres.

"Communication by wireless telegraphy to and from fixed stations with moving trains is no longer an uncertainty," he said. "Railroads can now go ahead and install the service without any fear of failure. There are many fields for the wireless telegraph in railroad operation, in routine business, and emergencies when lives and property can be saved by its use.

"And the service can be put into operation without increasing the train staff Regular trainmen can easily learn the telegraph alphabet or telegraph operators on trains can perform the duties of trainmen. Later it may be found necessary and profitable to place a telegraph operator on limited trains running long distances without stopping to handle commercial telegrams for the public.

"In my opinion the wireless will revolutionise railroading. The time is coming, and it is not far distant, when the wireless telegraph on trains will make the safety and convenience of railroad travelling 100 per cent. greater than they are to-day, and as a preventive of accidents I think the wireless will prove of the greatest value.

"In the Hudson tubes and subway, for example, the train dispatcher sits in his room, and by the flashing of lights knows where every train is. If two trains get



Scranton Railway Station. Showing the Aerial for Wireless Telegraphy.

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The Lackawanna "Limited No. 3'

dangerously close together he can send a signal that will almost instantly stop one or both of them. I believe that the same thing can be done on railroads with the wireless. The dispatcher can sit in front of a board on which the location of each train will be shown by wireless telegraph. If he sees trains getting too close together for safety, he can send a wireless message that will stop one of them anywhere—out in the country miles from a telegraph station.

"But, of course, all this is in the future. At present we are only experimenting. As far as they have gone, however, the experiments justify the predictions.

"Our doubt when we contemplated installing the wireless was about using the rails for grounding the electric current. There is a ground wire at every wireless station, but you can't have one from a moving train. So we tried sending our ground current to the rails. The scheme worked well and the first difficulty was overcome.

"And another problem was settled at the same time, that of supplying the electric current for the messages. We simply used the dynamos already in the train for lighting purposes. We had feared that they would not furnish sufficient current for the wireless, or if they did, that using it would weaken the lights. But we used all the electricity we needed and the lights were not perceptibly dimmed. I think it is certain that we can use the rails for ground wires and the ordinary lighting dynamos for our current. This was demonstrated.

"Our next problem is to get our instruments on the train absolutely in tune with those at Scranton and Binghamton. You see, on account of the tunnels and low bridges over the tracks we cannot have a high aerial on the train, but high aerials are necessary if messages are to be sent any great distance, so we built them high at the stations and work them with a low aerial on the train. This makes the transmitting of messages between the train and the stations more difficult, but I believe this difficulty can be overcome.

"We have sent and received messages so easily that we are convinced that the only thing required to perfect the service is a perfect adjustment of the instruments. We shall make an experimental trip every other day until this adjustment is satisfactory. Then the wireless service on the Lackawanna Limited will become a regular thing."

Setting signals by wireless is the next step, according to Mr. Foley. He said that if an operator wishes to set a signal for a moving train not in communication with him he can cause the semaphore blade of the signal post to rise or fall at his will by sounding the correct dots and dashes on his key.

"Signals can be set by wireless," he said, "as easily and as surely as they are now set by electricity conducted in wires.

"This means that if any mistakes are made in the orders issued to engineers and conductors at stations or in the case of any emergency in which a train must be stopped to avert an accident, the station operator can signal the train as certainly as if he had direct wire communication with someone on board.

"Another valuable use to which the wireless-controlled signals can be put is the handling of freight trains on long runs. At present a through freight must make many stops between its starting-point and destination, so that orders and instructions concerning right of way can be delivered to the conductors, but these frequent stops are a source of expense and delay which will be abolished by the wireless telegraph.

"Keeping freight trains in motion for long distances without stops will result in great economy of operation. Railroad

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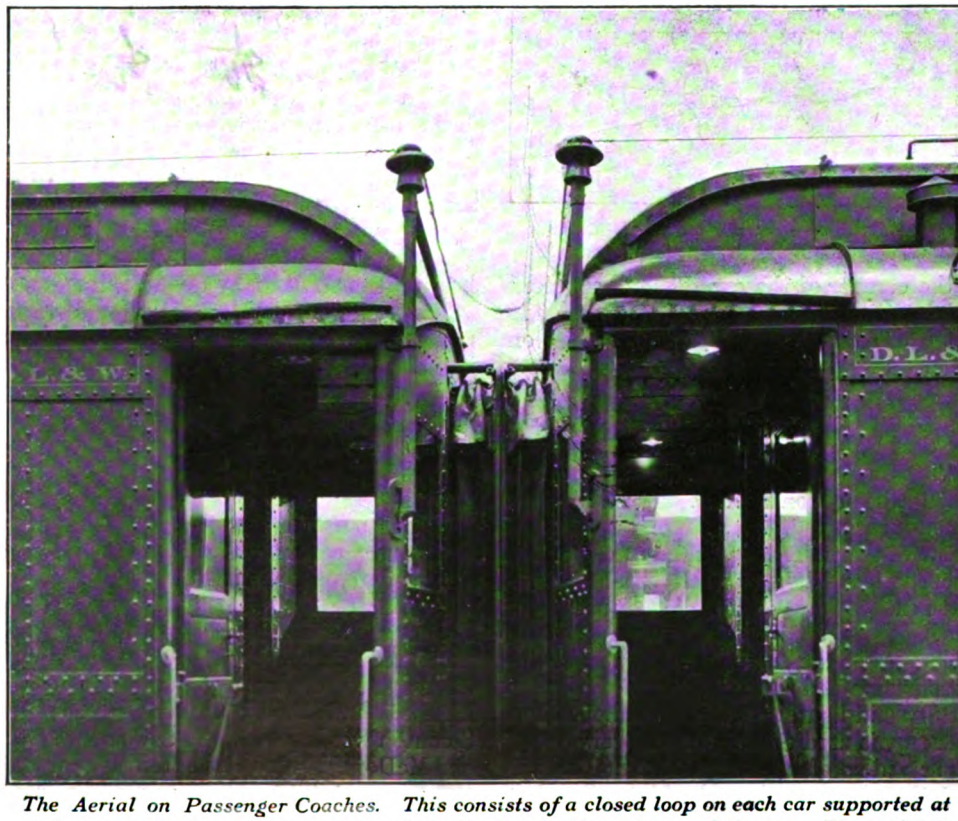
operating officials know how expensive it is to start and stop heavy freight trains, the additional cost of fuel with the attendant pulling out of drawheads and the wear and tear of equipment being no inconsiderable items in themselves. With direct communication with a train and the ability to set and release signals by wireless, dispatchers can keep in touch with conductors and make the stops needless. The wireless permits the dispatcher to board every train and deliver his instructions as surely as if he handed them to the conductor in a sealed envelope.

"That the wireless service for ordinary operating purposes is no longer an experiment is proved by the fact that the Lackawanna has already depended upon it when wire communication was cut off. The railroad has used the wireless for handling train orders, and find it as accurate and reliable as the telegraph or telephone. Recently, when a severe sleet storm put all telephone and telegraph lines out of commission in the Mountain Division of the Lackawanna railroad, all train orders were handled by wireless between Scranton and Binghamton, where the railroad's two fixed stations are. The signals were strong and distinct, and the messages were received and sent by the operators without difficulty. The wireless was the only means of communication between Scranton and Binghamton for two hours during which fifty-four orders were transmitted."

Commercial telegrams have already been sent from the Lackawanna Limited and a set of regular toll rates is now being prepared.

The wireless apparatus on the Limited has been installed in the forward part of the train. The aerial consists of a quadrangular closed loop on each car, supported at each corner by insulators on iron pipe attached



The Aerial on Passenger Coaches. This consists of a closed loop on each car supported at each corner by insulators on iron pipe attached to the corners of the car. The aerial is raised 18 inches above the roof of the car.

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A Wireless Operator on the Train.

to the corners of the car. They are raised eighteen inches above the roof of the car, this being the maximum space allowable on account of bridges and tunnels. Four cars are thus equipped, the connection between cars being by means of a plug and socket. The aerial on each car is sixty-five feet long and is composed of a twisted cable of seven No. 18 silicon bronze wires. The car aerials are brought together at a point about the centre of the train and lead into the station, which is located in a small box-like compartment at one corner of the passenger cars.

The power for operating the train equipment is obtained from the generator storage battery and lighting outfit, and about 2 kw. of energy is used for the wireless service.

The radius of train operation at the present time is approximately fifty miles, but this range will be extended after the equipment has been tuned up.

The ground connection on the train is obtained through the steel trucks and wheels of the cars and rails.

The equipment on the train consists of a standard 1 kw. Marconi set of modern design, especially adapted to this service. The motor-generator is automatically controlled, the operator simply throwing on and off a switch, as necessary. A special feature of the installation is the limited amount of space required for it.

The distance between Scranton and Binghamton is about sixty-five miles, and in the experiments it was found possible to maintain communication from the train running at fifty-five miles an hour, part of the time direct from the train to the fixed station away from which the train was speeding, and when the train had proceeded to a point too far away for its short aerial to force signals through to this first station direct, the signals were delivered to the station by being picked up at the second station and relayed back. At no time during the tests was the train out of communication with both stations.

One of the most striking features in connection with train wireless was illustrated during one of the test trips, when news of the day was received while the train was travelling between Scranton and Binghamton at the rate of 60 miles per hour. Passengers were shown the latest despatches from the United States and abroad, 250 words having been sent to the train by the *Scranton Times*.

Railway men, both in the United States and elsewhere, have shown great interest in the tests. On December 17th Messrs. Logan and McDonald, of the telegraph department of the Pennsylvania railroad, made a two days' inspection of the Lackawanna wireless system. They spent the first day watching the wireless work between Scranton and Binghamton. On the second day they were at Scranton when Mr. Sarnoff, of the Marconi Company, on the Limited, fifty miles east of Scranton, sent a wireless message to Mr. Logan, introducing himself. From that time until the train, which was westbound, arrived in Scranton communication between the Limited and the Pennsylvania men at Scranton was kept up. Then Messrs. Logan and McDonald boarded the train at Scranton, the former taking the key in the wireless room. He sent messages to both Scranton and Binghamton.

Mr. Graf sent out the following call re-

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cently, while the Lackawanna Limited was forty miles from Buffalo and speeding toward that city: "Any radio station in Buffalo, adjust me." He repeated the call for twenty minutes, and finally received a response: "Who are you?" This was followed by "What position are you in?" Mr. Graf replied, "Operator on board No. 3 Lackawanna Limited speeding toward you."

The Buffalo operator, evidently believing that he was communicating with a vessel on the Great Lakes, asked, "What longitude and latitude are you in?" Once more Mr. Graf flashed back an answer, and this time it was understood. The Buffalo operator, Mr. Jackson, of the Marconi Wireless Telegraph Company of America, sent his congratulations on the success of the train wireless and met the Limited when it arrived in Buffalo.

The possibilities of wireless applied to railroads multiply almost constantly. Soon after the installation had been made on the Lackawanna Limited three tramps were discovered by conductor Simrell riding on the tank of the locomotive, unobserved by the engine driver and the fireman. The Limited was between Scranton and Binghamton at the time and the conductor did not want to stop the train to put the men off. Therefore he reported his discovery to Mr. Foley and Mr. Graf.

The wireless apparatus was put in operation and a message sent to Binghamton informing Mr. M. F. Collins, a special division agent of the railroad in that city, of the fact that the Limited was carrying three men who were without tickets. When the train pulled into the outskirts of Binghamton and slowed up, Mr. Collins and his assistants took the three into custody. The tramps were greatly surprised when they were told of the means employed to capture them, and apparently took pride in the fact that they were among the first of their class to take a place in the history of train wireless.

The first Lackawanna train order was sent on October 23rd from Scranton to Binghamton. It marked the first time in the history of the world that a train order was sent by wireless.

Wireless Operator at Scranton Railway Station.

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The Two Voices

Two Sonnets on Radio-telegraphy.

Dedicated by kind permission to Commendatore Marconi

I

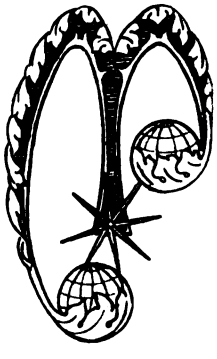
The Primitive Voice.

ILENCE, that mock'd at Life; untouch'd, intense,
Numbing the stagnant waters of the void,
Until divine compassionate wings deployed
The glory of their quickening influence,
And a wind rose above the waste Immense
In awful music, as it were God's breath
Creating souls beneath the ribs of Death,
And glowing worlds in its omnipotence.

Followed another voice. A primal sea
Interpreted unspanned Eternity
Into the flux of Time: and after these
Arose the voices of the plains, the trees,
Till, last, through all Creation's Song there ran
The modulate, well-tuned voice of *Man*.

II

The Ultimate Voice



OST POTENT by its reason'd Unity,
Man's voice was yet too utter weak to take
The Ear of the Invisible, and make
Far-reaching echoes through the lofty sky.
But the decree was urgent: "Strive and try,
For Life hath hid from you her treasure deep;
That learning how to win, ye learn to keep,
So that ye may be perfect by and by."

Now Man attains his birthright! He has found
The alchemy that, mingling Light with Sound,
Gives to the wandering ear a still, small voice,
Translating human speech. "O Earth! rejoice,
"E'en now through space,"—so the glad cry is hurled,
"Man speaks with Man: soon *World* shall speak with *World!*"

Bernard C. White

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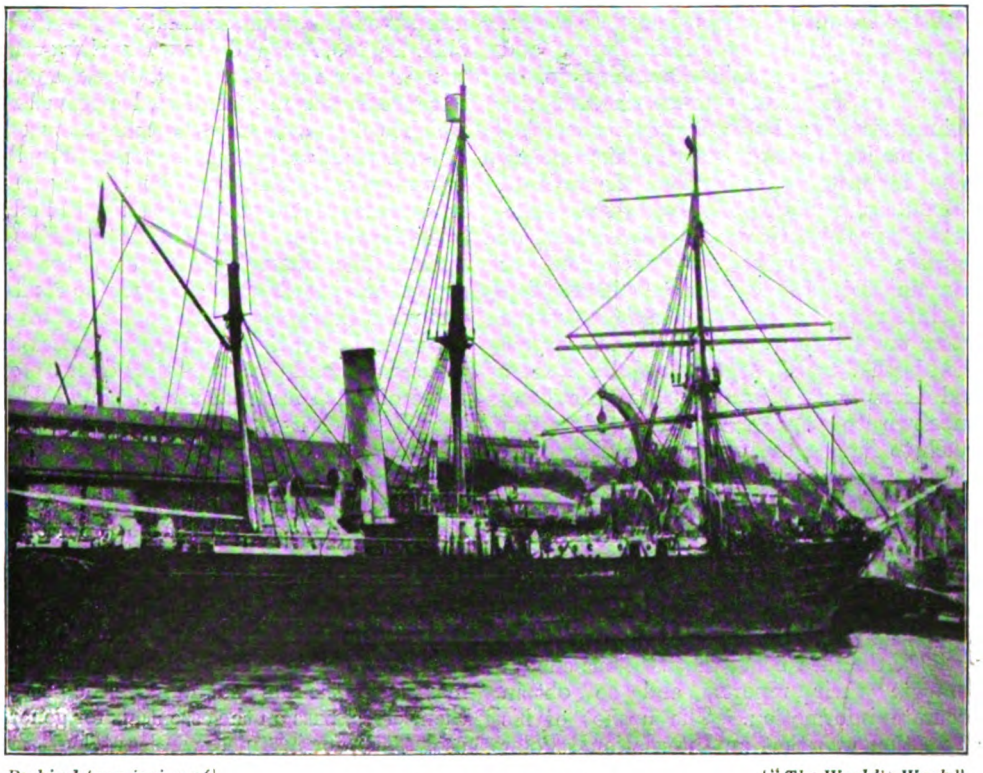
A History of Polar Exploration

THE PART WIRELESS HAS PLAYED. ITS FUTURE RÔLE IN POLAR RESEARCH.

THE recent death of Viscount Sidmouth has brought out the interesting fact that he was one of the last to say "Good-bye" to Benjamin Franklin, when the great explorer started out on his hapless mission to discover the North-West Passage. This is an unwelcome reminder of the price which we have paid for our polar discovery. At the same time we can take comfort from the knowledge that such a price need never be required again. It has been paid once and for all, for, with the advance of science, the dangers of research and exploration have been mitigated in a marvellous degree. Of course, danger is not all passed. Far from it: the fate of the Scott Antarctic Expedition is sufficient to warn us against taking too optimistic a view. Nevertheless aviation, the use of electricity, the thousand and one appliances of the modern scientist, and, by no means least, the invention of wireless telegraphy, avert many of the perils which beforetime stared the adventurer in the face. In the early



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THE "AURORA"

Built originally for whaling, this vessel has taken part in more than one voyage of Polar Discovery, for she was one of the relief vessels to the ill-fated Greely Expedition. Afterwards she was chartered by Dr. Mawson for her present work.

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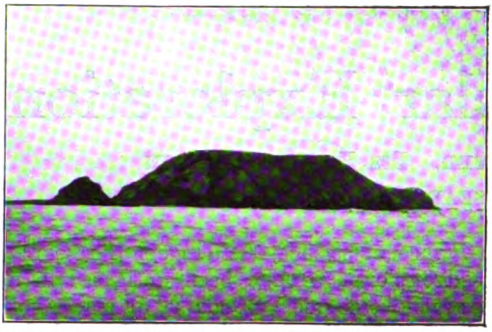

By kind permission of ["*The World's Work.*"

MACQUARIE ISLAND

A general view of this gaunt mass of rock.

days of exploration *robur et aes triplex* were his only *vade mecum*; now he augments his daring with scientific knowledge and a scientific equipment. He has the example and experience of many predecessors to aid him. The annals of Arctic discovery are thick with the names of heroes, many of whom, although they did wonderful work and passed through untold hardships, often death, are practically unknown and uncommemorated; but the world, nevertheless, makes use of their achievements. Who, for instance, remembers the work of John Rutt, who, in 1527, sought the North-west Passage to China, or John Davis, or Captain Waymouth, or Luke Fox, or Captain James? Even Collinson and M'Clure are only known to the few, yet the latter was the first to discover and traverse the North-West Passage. Sir John Barrow and Lieutenant Weyprecht are practically unknown to popular fame, yet they did much to further the work under discussion, for the former in 1818 was instrumental in passing a law through the English Parliament for the promotion of Polar discovery, and the latter, in 1875, was the first to start the idea of appointing ten international circum-Polar stations for establishing synchronous meteorological and magnetic observations, the idea being that stations should compare their reports, and so obtain accurate information. The upshot of his suggestion was that an International Polar Conference was held at Hamburg in 1879, under Dr. Geog Neumayer, and another at Berne in 1880, when various nations agreed to build twelve such stations, and this plan was eventually carried out. This did much to establish sound premises for the work of future explorers.

Of these it is difficult to mention individuals, expeditions and intrepid explorers become so numerous from this time to the present day, but there is a danger that while the fame of Nansen, Amundsen, Peary, Shackleton and Scott is ringing in our ears, the noble work of Scorsby, Parry, Austin and Major-General Greely is likely to be overlooked. This should not be, for the investigations, experience, and, above all, their records, alone made the more brilliant work of their successors possible, and it is not too much to say that these successors would themselves acknowledge their indebtedness to these pioneers of discovery. Scorsby, for instance, left to posterity writings which are still in the guide book of the geographer. They are to the explorer what Dr. Johnson's Dictionary is to the lexicographer, for although a large part of it is out of date, fundamentally it is unassailable. So, too, Austin did marvels of organisation in his expedition, and made special advance in the matter of sledge travelling, which is of no little importance if the success of an expedition is to be ensured. Finally, Parry paid special attention to hygienic arrangements, and obtained besides valuable scientific results. "Scientific results!" the remark has often been made; "we are always hearing about these scientific results, but what they exactly are nobody seems to know, and even if they are very interesting to scientists and professors they do not seem to be of much material use to the world at large." This is a poor argument, but it is one somewhat difficult to controvert, for, as the objectors justly remark, the data gained is usually only of use to experts. But it should be remembered that this is no proof of its worthlessness, for all admit that knowledge must of necessity only belong to the few who can grasp its value. Nevertheless, it becomes public property through such channels, for those few "elect," while they may keep the long-sounding principles to themselves, pass on the essentials for general use. Take, for instance, wireless telegraphy. It is only the scientist or the engineer who understands about the laws controlling electro-magnetic waves, and the many principles of sound, light and heat, magnetism, and kindred subjects upon which

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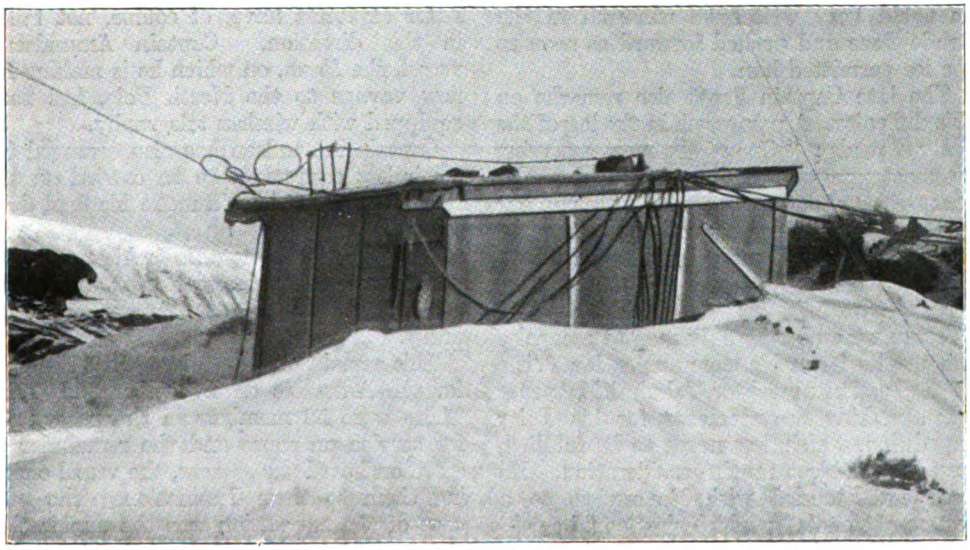
the invention is based. The operator need only acquire a tithe of this knowledge in order to work the instruments, and the general public who benefit by the invention knows practically nothing at all. But no one would dare to say that the patient research carried on in the laboratory and study which has discovered these laws has been waste of time and the lives spent in such research have been useless.

It is the same in Polar research: there is no limit to the extent in which the knowledge acquired may be used. We will take one instance. Fossil remains of mammoths have been discovered within the Arctic zone, thereby abundantly proving that at one time these regions of snow and ice were under the influence of torrid heat, and this fact, more than any other, has proved the assumption correct that at different times the earth passed through phases of extreme heat and extreme cold before it reached the equitable temperature which enabled mankind to exist.

But it is not so much with the actual results of Polar research that we are concerned as the means to be employed so that it may be carried on with the minimum of danger to the valuable lives spent in such work. And here, perhaps, wireless telegraphy has a use which makes it one of the most effective agents and the greatest safeguard that can be employed in such work. It is reasonable to suppose that had Captain Scott's expedition been equipped with a wireless station the brave men who lie buried beneath Antarctic snows would have completed a triumphant journey and would have themselves received the reward of their heroic labours from an enthusiastic and grateful nation. They were only eleven miles from the One Ton Depôt, where there was a store of food, and had they only been able to communicate they could have received assistance, for some of the party had quitted it to return to the ship but a few days before the disaster overtook their fellows.

The record of Dr. Mawson, who is at present encamped in Arctic surroundings in Adelie Land, are sufficient proof of this; but before discussing his experience it is worth while to consider how great is the need of an exploratory party for some means of communication with a permanent base.

It was this want which hindered Captain Young in his Polar work, for a report concludes: "At Upernavik the *Pandora*, after a stormy and dangerous passage, arrived to find that the last ship had sailed for Europe. As there was no means, therefore, of communicating with England, and as



THE TRANSMITTING STATION, MACQUARIE ISLAND.

The Wireless Cabin banked up with snow in the land of perennial winter. Despite the severe climatic conditions the apparatus worked splendidly.

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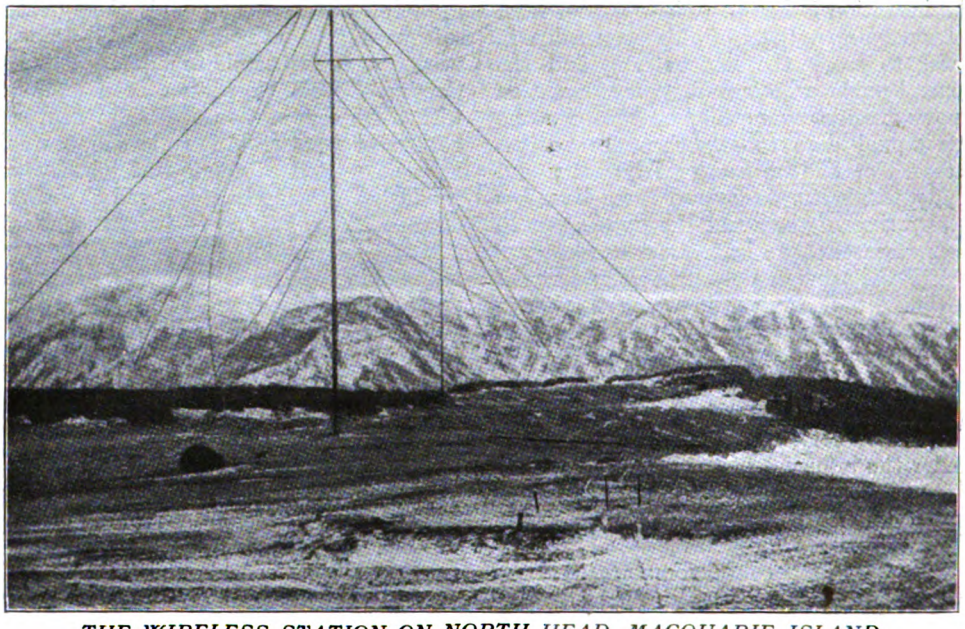

THE WIRELESS STATION ON NORTH HEAD, MACQUARIE ISLAND.

This is doing such important meteorological work that it is to be taken on by the Australian Government.

without such communication Captain Young did not feel authorised to winter in the north, a supply of fresh water was taken on board and the ship steered for home." As it was, he had to leave his work uncompleted when he could very well have wintered in the Arctic Zone and pushed forward as soon as the ice permitted him.

The late Captain Scott also remarks on this difficulty. A paragraph in the log of the *Nimrod* reads: "One of the most annoying circumstances was that until we had a solid sheet of ice about us we could not set up our meteorological screen nor communicate regularly with the magnetic huts, nor, in fact, properly carry out any of the routine scientific work."

These were not the only men to recognise the need of reliable communication. The great Russian navigator, Admiral Makaroff, when making arrangements for his Polar expedition, which was never to be fulfilled, gave this subject much consideration. He even corresponded with Nansen as to a system of signals by which they could get in touch with each other amongst the ice. (It should be explained that his aim was to render assistance in case of accidents to the Nansen expedition, which at that time was being fitted out.) His idea was clear, and had he lived in this age of wireless telegraphy there is no doubt that he would have made use of the invention to fulfil his purpose. Later explorers have, of course, not failed in this direction. Captain Amundsen's vessel, the *Fram*, on which he is making his new voyage to the North Pole, has been equipped with wireless telegraphy.

Captain Amundsen has also arranged for a wireless equipment to be carried on the sledges in which he will make his final dash to the Pole.

But the most notable achievement of wireless in Polar exploration is the record established by Dr. Mawson and his party.

This expedition left Hobart, New Zealand, for the Antarctic on December 2nd, 1911. There were 52 members in the party; 31 for service on shore and the remainder to serve on board the *Aurora*, the vessel carrying them to their destination. The purpose of the expedition was the exploration of the coastal region of the Antarctic Continent lying south of Australia, for Dr. Mawson believes that a scientific examina-

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tion and accurate survey of the region will be likely to prove the possibilities of great economic development. The *Aurora* is a vessel which has long since made her maiden trip to Polar regions, for thirty-six years ago she took part in the search for the ill-fated Greely Expedition. She is a whaler, heavily timbered to withstand enormous ice-pressure, and is well supplied with all things needful for her present purpose. On arrival at the mainland of unknown Australian Antarctica the shore parties were distributed as follows:

Mr. Ainsworth, of the Commonwealth Metereological Service, and a party of four were landed at Macquarie Island on December 13th, 1911. One of the four was Mr. A. J. Sawyer, at the time member of the Gisborne and Wellington Telegraph Staffs, who resigned in 1908 to take up "wireless," and was afterwards commissioned to superintend and man the proposed wireless station on the island. His description of the difficulties encountered in his work is interesting:

"All stores and wireless equipment had to be landed through the surf—not a difficult proceeding, but a wet and cold one. A barrel containing a part of the wireless equipment came adrift and we thought it was lost for good. But it was cast up on the shore two days later, though the contents were scarcely improved by the long immersion. Owing to the fearful gales and bad weather the task of erecting the wireless plant was a difficult one. We had to haul everything up a 300-foot hill, and several minor accidents occurred during the work of transit, while a good many of the instruments had to be repaired before the actual work of erection could be proceeded with. Throughout, my only assistant was a Sydney wireless amateur, who, however, made himself invaluable to me.

"On the 6th of February everything was ready for the initial trial. Unfortunately, a violent hurricane sprang up that afternoon, carried the aerials away, and damaged the masts, but in a week's time repairs had been effected, and on the 13th communication was established with shipping and Sydney."

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DR. MAWSON'S MAIN BASE IN KING GEORGE V. LAND.

This is a very fine harbour, and there is ample evidence of land as well as ice. Dr. Mawson, with seventeen men, has continued scientific investigations here for over two years.

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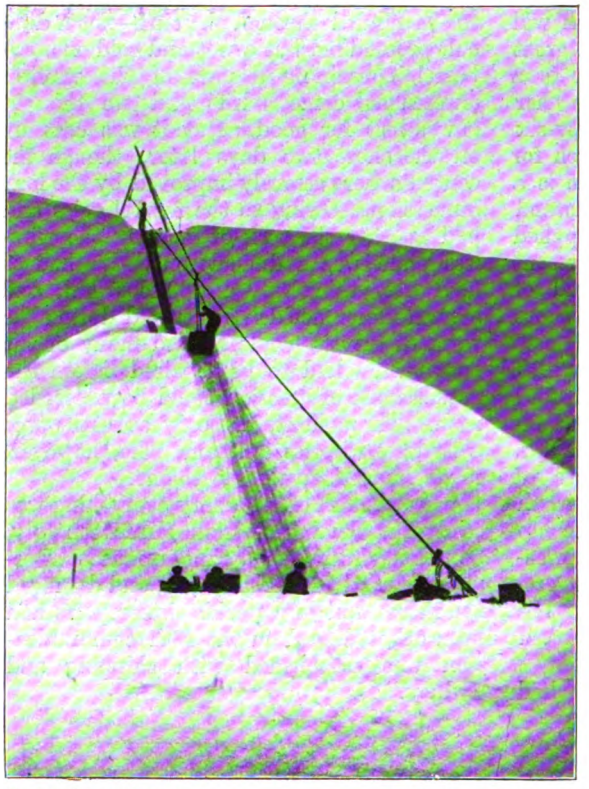

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HAULING STORES UP AN ICE-CLIFF.

A scene at Dr. Mawson's second base, where the party under Mr. Wild wintered on a moving glacier, a most daring exploit which, however, was attended by no misfortune.

This station supplies meteorological data each night to Melbourne and Wellington by wireless, and has proved so valuable that it has been taken over from the Expedition by the Commonwealth of Australia, and will in all probability be maintained by them. Several excellent results in the way of long-distance communication have been recorded; for instance, messages were transmitted to and received from Port Moresby land station, 2,800 miles away; Suva land station, 2,400 miles; Freemantle land station, 2,200 miles; also from the steamers *Manuka* and *Cooma*, both over 2,300 miles distant.

At Macquarie Island the *Aurora* bumped heavily on rocks and sustained severe damage, which necessitated almost continual work at the pumps, and subsequently cost £2,000 to repair.

Dr. Mawson and the remainder of the party had meanwhile set out for the lesser known district further south. They successfully weathered the stormy conditions of the "Roaring Forties, Howling Fifties and Shrieking Sixties," and eventually discovered a magnificent harbour, afterwards named Commonwealth Bay, where it was decided to establish a base. Provisions, coal, and Greenland sledge dogs for eighteen men were landed, and the ceremony of hoisting the British flag in the new territory was performed. It was called King George V. Land. Afterwards, a wireless station was erected here, which has been working successfully since January, 1913.

The *Aurora* then sailed westward, to land the third party of eight men, but the ship covered 1,100 miles without being able to find a landing-place. Where ice-floes did not intervene they were thwarted by unscalable ice-cliffs, and when their supply of coal began to run short they were forced to consider the advisability of returning to Australia with their ambitions unfulfilled. But such a prospect went hard against the grain, so the little company took their lives in their hands and elected rather be "dumped" on a glacier with their camp 17 miles distant from land, and with 200 fathoms of water beneath them. As it was discovered on Sir Ernest Shackleton's birthday this ice-tongue, which is 120 miles long, was named the Shackleton Glacier, while the adjoining land, which was afterwards explored by the party, has been loyally christened Queen Mary Land. The danger of this Antarctic escapade is evident, for had the ice-tongue broken away during the vernal thaw the whole party would inevitably have been lost. As it is, their work under Mr. Frank Wild justified the hazard, for they have returned to Australia with the charting of a great part of the Antarctic coast completed and much research accomplished in oceanography.

But it was imperative that Wild and his men should be relieved, for the season was

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late, and a vessel penetrating the pack ice under such conditions is likely to be frozen in and jammed among the bergs in the darkness. As the efforts of the search parties to discover the missing explorers were unsuccessful, Capt. Davis decided to proceed to Wild, and had already proceeded some distance along the coast in the teeth of fearful gales when a wireless message was received from Adelie Land, saying that Mawson had come in alone.

The first disaster to overtake the three heroes was the death of Lieut. Ninnis, which occurred when the three men were 300 miles from the main base. The unfortunate man with a team of dogs and nearly all the food was suddenly precipitated down a crevasse, and, it is believed, instantly killed. The position of the two survivors was thus rendered desperate, and they instantly retraced their steps. For 35 days they struggled on without adequate provisions. Then, on January 17th, Mertz died from privation. For another three weeks Dr. Mawson continued his lonely journey, and finally reached the base on February 7th.

With this news came the order for the *Aurora* to return at once and take off the whole expedition. But an effort to do this was frustrated by the tempestuous conditions, and Capt. Davis, using his own discretion, determined first to relieve the heroic little band stationed on the far-off glacier to the west. "On February 9th," so his report runs, "we were brought up by heavy ice, and it appeared unlikely that we should get through at all. The presence of countless bergs made navigation in the darkness almost impossible, and as daylight came we were thankful that we had passed another night without disaster. These experiences continued until February 23. The morning of that day dawned bright and clear, and we calculated that we ought to be near Wild's base. So, with eyes glued to our glasses, we searched the coast and perceived a little hut on the

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PLOUGHING THROUGH PACK-ICE.

This is very dangerous work, especially if the severer season is setting in, for in the darkness the ship is liable to be frozen in and crushed by the pressure of the newly forming ice.

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glacier with a solitary figure outside it. Soon there were eight gesticulating black figures, and we knew that the whole of the party was safe and sound. Then began the work of bringing aboard the members and all their specimens and collections, and this we did in the remarkably short space of six hours."

With the rescued the *Aurora* then sailed for Hobart, arriving there in March, 1913. But Dr. Mawson and his party, which includes six of the men sent out by the *Aurora* to search for their leader, have been forced to spend another year in the Antarctic. They are well supplied with coal and food, and their scientific equipment, and there is no reason to suppose that they are running any further risks by the delay. Besides, they have the wireless to keep them in touch with the outer world, and from the reports that reach us from time to time they find an invaluable aid both to their work and recreation. It is an unfailing source of cheerfulness, for to be able to "talk" to "passers-by" is the most exhilarating tonic that men in their position can have. Not only can they "talk" themselves, but they can hear other stations at work. "They get messages which Wellington, Melbourne and Sydney exchange with each other. Sometimes they hear warships 'talking,' sometimes luxurious liners. They are a little party of outcasts in a deadly wilderness, listening eagerly to the tag ends of the world's conversation. Occasionally Dr. Mawson discusses through Macquerie Island and Hobart how Sydney shall dispose of certain scientific specimens already brought back to Australia by the *Aurora*. They send news of the weather, of the good spirits they manage to keep up, and of the team dogs' puppies. More than this, they have sent New Year's greetings to their compatriots, loyal messages on Empire Day, and they have already conveyed their sympathy to Lady Scott on the loss of her gallant husband. But perhaps their most noteworthy achievement is the publication of an Antarctic newspaper, with, as the saying runs, 'all the latest news.'"

With such experiences to guide them we doubt whether any explorers of the future will organise an important expedition without including an adequate wireless equipment. Captain Amundsen has, as we have already seen, taken the hint; so has the relief expedition which was sent out to obtain news of the ill-fated Schroeder-Stranz Expedition, and which arranged to set up wireless communication with the German Colony at Cross Bay *via* the station at Spitzbergen. A party of scientists from the United States who chartered a Newfoundland vessel and sailed last summer to carry out observations in the Arctic Zone, installed powerful instruments on the ship so as to keep in touch with the new radio station at Wolfsteinholm, on Hudson Strait. Then there is Dr. Vilhjalmar Stefansson, well known for Polar exploits, who recently left civilisation for another four years' Arctic exploration. He intends to establish a primary base on Herschel Island, and a secondary base on the south-west corner of Northern Victoria Land. Wireless stations will be erected at both points, and will be capable of sending 1,000 miles, so that not only may the members of the expedition be able to communicate with each other, but will also be in direct communication with a large slice of the world. Finally it is reported that the new French Arctic Expedition, under M. de Payer, an officer of reserve and Member of the Geographical Society, has been entrusted by the French Government with an important scientific mission, which is to include the establishment of a Government station within the Arctic Zone, which is to be in constant communication with France by means of wireless telegraphy.

Such is the history of wireless as regards Polar exploration, and it is not too much to say that it has opened up and made possible, without grave risks to life, a vast field of achievement in Polar research.

An Austrian Antarctic expedition proposes to leave Trieste early in June in the steamer *Oesterreich*. After touching Buenos Ayres the party will proceed to South Georgia, where an intermediate wireless telegraphy station will be installed which will enable the ship to keep in communication with the outer world.

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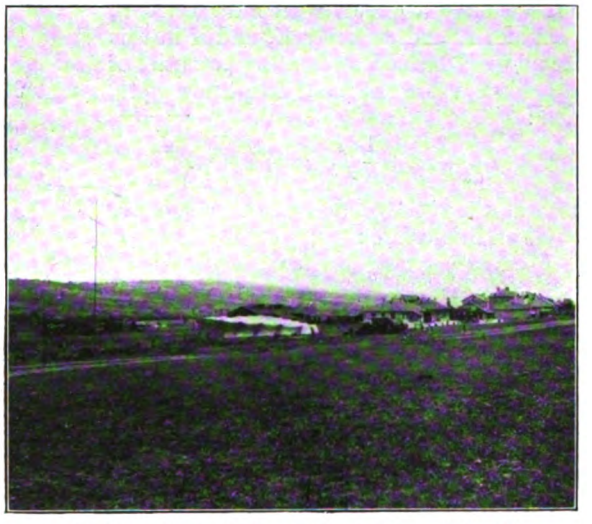
In Terra, Pax

Wireless with the Roumanian Army

EVENTS to-day move so fast that Plevna has almost become nothing more than a memory to the average Englishman; but the Balkan peoples will long remember it as the scene of one of the bloodiest battles of that internecine strife. To think that glory should cost such a price, and that some of the flower of Balkan manhood stained the disordered field with good red blood, to win a bubble reputation even in the cannon's mouth. Plevna would be well forgotten if it were only the scene of human sacrifice, for what is military glory to those who mourn the dead? Fortunately Plevna can boast a better fame than this, for during the war the Marconi apparatus stationed here did much more than merely assist in the conflict. It was the means of bringing relief to the suffering, courage to the despondent, and, best of all, it was the means of assisting the well-disciplined army to concentrate its forces and organise its plan of campaign to such good purpose that, like a modern Hercules, it throttled the many-headed snake of war.

But Plevna was not alone to enjoy the advantage of a wireless telegraph station, for the Roumanian army made extensive use of wireless telegraphy during the campaign in Bulgaria. The stations used were of the Marconi system, 1·5 kw. type, having a range of transmission of 250 kilometres (about 155 miles). These were distributed amongst the Commanders of the Army Corps, the Commanders of the Depôts, the Commander-General of the Army, and one station was erected at Bucharest, by means of which the War Office was able to keep in direct touch with the movements of the army in Bulgaria. Each of the above-mentioned Commanders were provided with one station, with the exception of the Commander-General of the Army, who had two stations. In all, seven Marconi portable sets were supplied, and these ensured regular radiotelegraphic communications between the country and the various Roumanian Commanders in the field. Up to August 1st, about 6,000 telegrams were handled and about 120,000 words were dealt with.



Headquarters of Roumanian General Staff at Plevna.

Such service is perhaps one of the greatest that an invention can offer mankind. All the world acknowledges the debt of gratitude it owes to Mr. Marconi for the security he has gained for those travelling by sea, but, well deserved as this gratitude undoubtedly is, the added cause for thankfulness here alluded to should not be forgotten. For, remember, wireless telegraphy has revolutionised military warfare, and has brought the science of military tactics to such a degree of exactness that in the hands of a skilled commander it is practically possible to eliminate mischance.

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The Measurement of Decrement

By J. ST. VINCENT PLETTS

SOME time ago, when investigating the oscillations in coupled circuits which were not in tune, I deduced an expression for the decrement in a particular case, which differed from that in general use, and, although I have not yet considered mathematically the complete case, experiment shows that my expression applies equally well to it.

The expression which I obtained may be arrived at in the following way:

If we have a circuit with inductance L, resistance R and capacity K, and if in this circuit we induce an alternating potential of maximum value E, and frequency $q/2\pi$, then:

$$L\frac{dc}{dt}+Rc+\frac{1}{K}\int cdt=E\ sin\ qt.$$

If v is the voltage across the condenser $c=K\dot{v}$ and therefore:

$$LK\ddot{v}+RK\dot{v}+v=E\ sin\ qt.$$

If we neglect the initial transitory terms the solution of this equation can be shown to be of the form:

$$v=V sin\ (qt-\theta).$$

Now if we assume that the resistance, R, is so small that it has no effect upon the natural frequency $p/2\pi$ of our circuit, we shall have $p=1/\sqrt{LK}$, so that, putting the above value of v into our previous equation and rearranging, we get:

$$\frac{E}{LK}sin\ qt=V\left\{(p^2-q^2)sin\ (qt-\theta)+\frac{Rq}{L}cos\ (qt-\theta)\right\}$$

$$=V\sqrt{(p^2-q^2)^2+\left(\frac{Rq}{L}\right)^2}\ sin\ (qt-\phi)$$

where ϕ is some other phase difference due to the combination of the sine and cosine terms.

If now we neglect the sines, and take simply the maximum values, we see that he maximum current:

$$C=KVq$$

$$=\frac{Eq}{L\sqrt{(p^2-q^2)^2+\left(\frac{Rq}{L}\right)^2}}$$

This, of course, is the equation for the resonance curve, and when $p=q$ gives the maximum value:

$$C_m=\frac{E}{R}$$

From this we obtain:

$$\frac{C}{C_m}=\frac{Rq}{L\sqrt{(p^2-q^2)^2+\left(\frac{Rq}{L}\right)^2}}$$

But if δ is the decrement

$$\frac{R}{L}=\frac{\delta q}{\pi}$$

and therefore

$$\left(\frac{\delta q}{\pi}\right)^2\left(1-\frac{C^2}{C_m^2}\right)=\frac{C^2}{C_m^2}(p^2-q^2)^2$$

$$\delta=\pi\left(\frac{p^2}{q^2}-1\right)\sqrt{\frac{C^2}{C_m^2-C^2}}$$

It is obvious, since the decrement must always be positive and the expression has been obtained by taking the square root, that we can write it in the form:

$$\delta=\pi\left(1-\frac{\lambda^2}{\lambda_w^2}\right)\sqrt{\frac{C^2}{C_m^2-C^2}}$$

where λ_w and λ are the wave lengths of our circuit and of the circuit inducing the potential in it (or, in other words, of the wavemeter and the circuit under measurement) respectively. I need hardly add that the ordinary expression for the decrement is:

$$\delta=2\pi\left(1-\frac{\lambda}{\lambda_w}\right)\sqrt{\frac{C^2}{C_m^2-C^2}}$$

and that the two expressions are identical if the two wave lengths are very near together, because the difference between unity and a number near unity is half the difference between unity and the square of that number.

I am, of course, aware that the new expression has been obtained on the assumption that the circuit under measurement has no decrement, but if this assumption be

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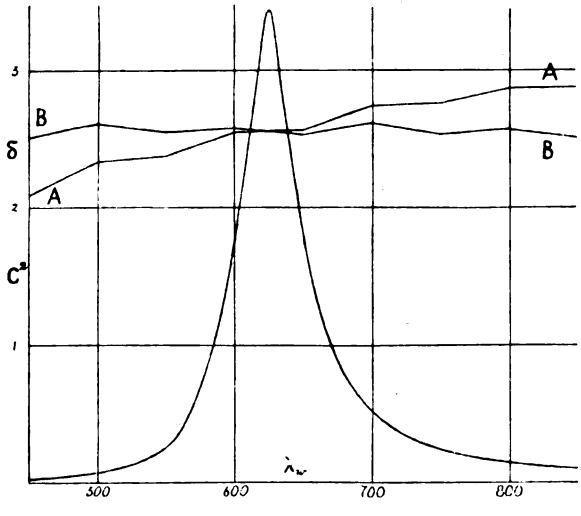
made in the old expression it does not produce the new one. It therefore seemed probable that an erroneous expression had come into general use owing to the continental habit of dealing with the decrement per half period, and that if the true expression were used the necessity for taking the two wave lengths close together would disappear. This point could obviously be settled experimentally. In the accompanying figure I give a resonance curve, which was taken from an impulsed circuit some years ago, together with the values of the decrement, calculated from this curve by the old (A) and the new (B) formulæ, for each value of λ_w. It will be seen that the latter gives a practically constant value



for the decrement, and, what is of much more importance, enables all the observations to be compared, and the mean value and probable error to be determined.

With resonance curves taken from ordinary wireless circuits when in operation, it will very often be found that the decrement given by this new formula is a constant on one side of the curve but not on the other. This appears to be due to the presence of another wave of insufficient amplitude to make itself otherwise visible on the resonance curve. In such cases it seems probable that, if the constants be determined from one side of the curve, and the other side be calculated from these constants, the difference between the observed and the calculated curves will give the otherwise invisible resonance curve of the other wave length.

SCIENTIFIC NOTE

MEASUREMENTS OF RADIO-TRANSMITTED ENERGY.—An interesting article by Mr. M. Reich on some results of quantitive radio-transmission observations recently appeared in *Physikalische Zeitschrift*. Measurements were made simultaneously of the current strength in an antenna at a sending station, and in a tuned antenna at the receiving station. The ratio of received to sent current was measured at various wave-lengths, and also at various distances; that is, between different pairs of stations. Over a short distance (7 km.) the observed received current was about 15 per cent. short of the computed received current with 1-km. waves, neglecting absorption, this loss being possibly attributable to imperfect ground conduction. With quarter-kilometre waves the loss increased to about 33 per cent. Over long distances (a few hundred kilometres) the observed received current was only about half of the computed received current. The indicated loss was thus about 50 per cent. The loss was found to increase with the frequency, being greatest on short wave-lengths. Over hilly country it was greater than over flat alluvial soil. At night time the loss was in general considerably less than in the daytime, but was subject to greater fluctuations. About sunset the received current strength was found to undergo marked fluctuations. The particular sunset observations indicated two marked *maxima*, separated by about ten minutes of time. In this case both stations seem to be approximately on the same meridian, and the date seems to have been at the end of November. These two rapidly-succeeding maxima, with a depression between them, might be explained by the solar shadow-wall theory. If so, the phenomenon of sunset double maximum should disappear at solstices, so far as concerns this particular pair of stations.

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Safety of Life at Sea

Compulsory Wireless Telegraphy

THE London International Conference on the Safety of Life at Sea, by which the Convention signed on January 20th has been drawn up, met for the first time on November 12th, 1913, at the Foreign Office, and has been sitting continuously since, except for a short break at Christmas. The suggestion that such a Conference should be held emanated from the German Emperor, and the task of convening it was undertaken by the British Government. The following States have been represented: Great Britain, Germany, the United States, Australia, Austria-Hungary, Belgium, Canada, Denmark, Spain, France, Italy, Japan, Norway, the Netherlands, Russia, Sweden, and New Zealand. The delegations from the different States were composed, not of the representatives of the shipping trade, but of administrators, experts and jurists.

Lord Mersey was appointed Chairman of the Conference. To deal with the specific subjects submitted to it the Conference appointed five sub-committees, together with a sixth sub-committee for drafting the Convention, which was to embody the recommendations of the Committees as approved by the whole Conference. The Committees and their respective chairmen were as follows:

Certificates Committee—Dr. von Koerner, principal German delegate.

International Drafting Committee—M. Guernier, principal French delegate.

Construction Committee—Admiral Capps, U.S.A.

Boats and Safety Appliances Committee—Sir John Biles (Great Britain).

Wireless Telegraphy Committee — Mr. Moggridge (Great Britain).

Safety of Navigation Committee—Sir Norman Hill (Great Britain).

The Conference agreed that the actual text of the Convention, which contains no fewer than 74 articles, should not be officially published until February 15th., in order to give the Delegations of the various contracting States time to communicate it to their respective Governments.

An outline of the principal results achieved was, however, indicated in the speech in which Lord Mersey moved the adoption of the Convention at the meeting of the Conference on January 19th; and the Conference resolved that the substance of this speech should be communicated to the Press as summarising the principal provisions of the Convention.

The following extract from the speech of Lord Mersey relates to wireless telegraphy:

The Convention provides that all merchant vessels of the Contracting States when engaged upon international (including Colonial) voyages, whether steamers or sailing vessels, and whether they carry passengers or not, must be equipped with wireless telegraphy apparatus if they have on board 50 persons or more (except where the number is exceptionally and temporarily increased to 50 or more owing to causes beyond the masters' control). The Contracting States have, however, discretion to make suitable exemptions from the requirement to carry wireless apparatus in certain cases, of which the most important is that of vessels which in the course of their voyage do not go more than 150 sea miles from the nearest land. The classification of the vessels, required by the Convention to be provided with wireless apparatus, follows the categories contemplated by the Radiotelegraphic Convention. The precise classification is too complex to be summarised, but, broadly speaking, the fast passenger steamers are placed in the first category, other steamships intended to carry 25 passengers or more in the second category, and all other vessels required to be fitted with wireless apparatus in the third category. It need hardly be said that the owner of any vessel placed in the second or third categories can claim that his ship shall be placed in a higher category, if it complies with all the requirements.

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A continuous watch for wireless telegraphy purposes is to be kept by all vessels required to be fitted with wireless apparatus, as soon as the Government of the State to which the vessels belong is satisfied that such watch will be useful for the purpose of saving life at sea ; and meanwhile (subject to a transitional period for fitting wireless installations and obtaining the necessary staff) the following vessels will be required to maintain a continuous watch, in addition, of course, to all vessels placed in the first category :

(1) Vessels of more than 13 knots, which carry 200 or more passengers, and which make voyages of more than 500 miles between two consecutive ports ;

(2) Vessels in the second category during the time they are more than 500 miles from land ;

(3) Other vessels, required to be fitted with wireless apparatus, which are engaged in the transatlantic trade, or whose voyage takes them more than 1,000 miles from land.

Vessels placed in the second category, but not required to keep continuous watch, are nevertheless required to keep such watch for at least seven hours a day, besides the watch of ten minutes in each other hour required by the Radiotelegraphic Convention. Vessels concerned with the fishing and whaling trade are not required to keep a continuous watch. The continuous watch may be kept by certificated operators or by watchers qualified to receive and understand signals of distress, and provision is made for the possibility of the future invention of an automatic apparatus which will take the place of watchers. The wireless installations must have a range of at least 100 miles and an emergency apparatus, placed in conditions of the greatest safety possible, must be provided unless the main installation is placed in the highest part of the ship, and in the conditions of the greatest safety possible. The Convention provides that the master of a ship in distress shall have the right to call to his assistance from amongst the vessels which have answered his appeal for help the vessels which he thinks can best render assistance, and the other vessels which have received the call may then proceed on their way. A transitional period is provided to enable wireless apparatus to be fitted and operators and watchers obtained.

AERIAL CONDUCTORS

PARTICULARS of Patent No. 4514, relating to improvements in aerial conductors for use in wireless telegraphy granted to Marconi's Wireless Telegraph Co. and Mr. C. S. Franklin, have now been published.

It is known that an aerial consisting of one or more turns of wire wound in the shape of a rectangle or other polygon and placed with its plane vertical to the earth has good directional properties for transmitting and receiving electromagnetic waves, but is a very inefficient radiator or absorber of these waves. It is also known that the radiation and absorption are greatly improved by employing one turn enclosing as large an area as possible and by inserting a small condenser in series with the aerial so that the latter is in tune with the wave to be transmitted or received. Even when this is done the dimensions of the aerial are still small compared with the wave length, and the aerial is therefore an inefficient radiator and absorber of electromagnetic waves. According to this invention condensers are introduced at approximately equal distances all round the closed aerial circuit, the capacity of each condenser being so adjusted that for the particular wave-length to be used it just compensates for the inductance of the part of the circuit joining it to the next condenser. The condensers may be conveniently placed in waterproof cases at the tops of masts which support the aerial, and in practice coils of high inductance should be placed in parallel with each condenser to prevent electrostatic charges accumulating. If desired, the earth may be made to form the lower side of the rectangle or polygon. The distance between the two extreme parts of such an aerial circuit may be as great as half a wave-length and the aerial will then be a very powerful radiator and absorber of electromagnetic waves and at the same time will have the good directional properties of a small closed circuit.

Dr. Filippi with his exploring party for the Western Himalayas is near Skardo. He is erecting a wireless installation with which to secure communication with the radio station at Lahore.

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The British Coast Wireless Service

Post Office Re-organisation Scheme.

THE design of the new Post Office station at Fishguard (G.R.L.), which was opened for commercial work on September 8th, 1913, and replaced the station at Rosslare, possesses many features of interest. It is one of the stations which come within the reorganisation scheme of the wireless coast stations undertaken by the Post Office to put the coast communication upon a satisfactory basis. The station has been erected at the top of the cliffs near the harbour village, and as an addition to the facilities at Fishguard Harbour it will be of great convenience alike to the travelling public and the Great Western Railway Company. The construction of the buildings was undertaken by the railway company, and the Post Office provided the equipment, which is on the Marconi principle. The range of the station is reckoned to be about 250 miles in the daytime, but it has taken traffic up to 1,200 miles at night. The necessary power is obtained from the Great Western Railway Company's generating station at the harbour. The high mast reared among the cliffs forms a landmark for miles around.

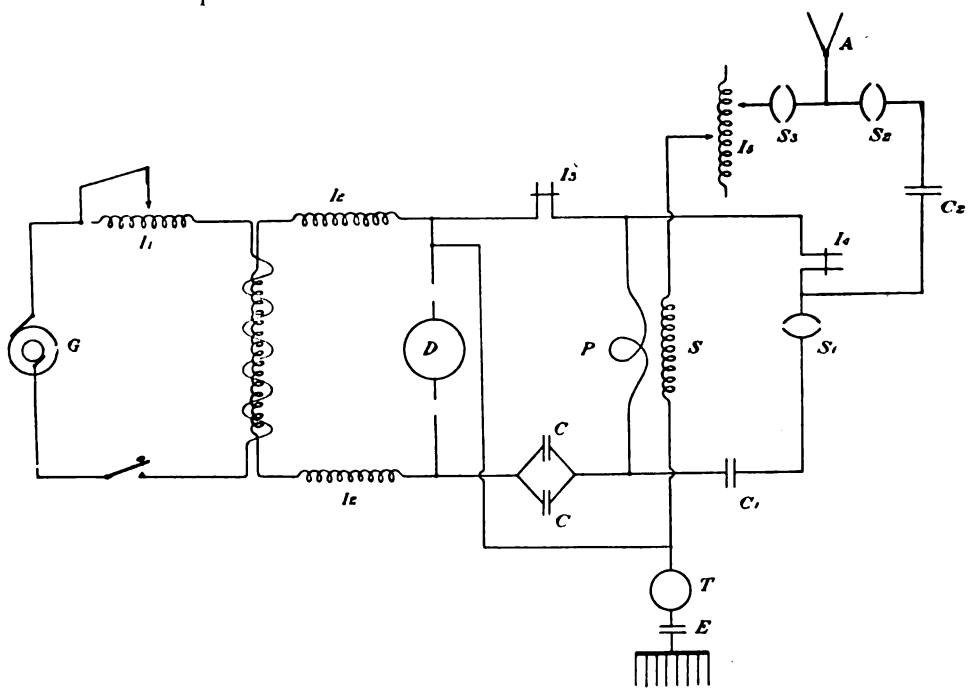

Fig. 1. Fishguard Wireless Station. Skeleton Diagram of Connections.

The design of the station is described in the *Post Office Electrical Engineers' Journal*, by E. S. Perrin and F. W. Davey, and we would like to acknowledge the courtesy of the editor of the Journal for permitting us to make the following abstract, and for the loan of diagrams and photographs from which the accompanying illustrations are made.

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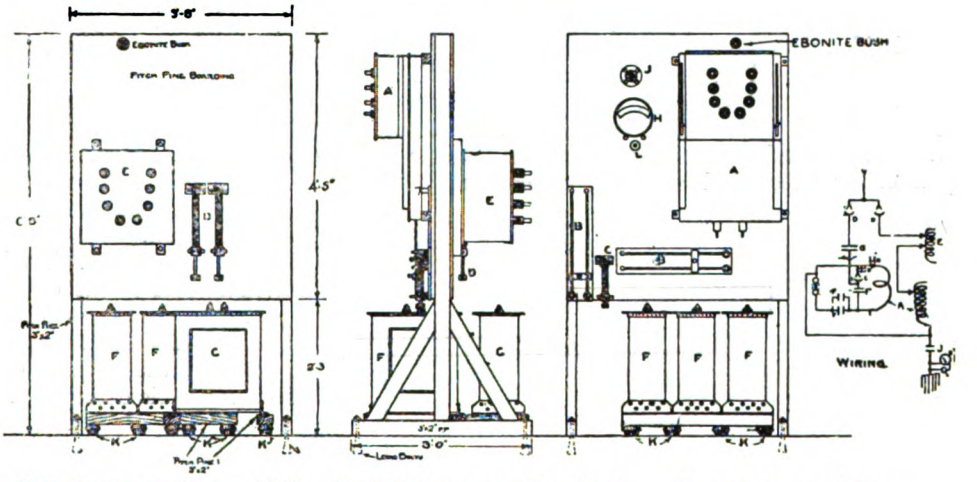
The skeleton diagram of connections is given in Fig. 1.

The arrangement is similar to that installed at North Foreland, but the power used is greater.

G is the alternator supplying 3 kw. power at a voltage which can be regulated between 200 and 400 through an iron core choke, I_1, to the primary of a high-tension transformer. The secondary of the transformer is connected through two air core chokes to a rotary disc discharger, D, which is fitted with 12 studs. Round the disc discharger are formed two circuits, one tuned to a 600-metre wave consisting of the discharger, D, condensers, C, C, the primary of an oscillation transformer, P, and an inductance, I_3; the other (when the switch, S_1, is closed), tuned to a 300-metre wave, consisting of the disc discharger, D, condensers, C, C and C, and inductances, I_4 and I_3. The 600-metre aerial circuit (operative when the switch, S_3, is closed) is inductively coupled to the 600-metre closed circuit through the oscillation transformer, P.S. Included in the aerial circuit is a variable inductance, I_5, a thermoammeter, T, and an earth arrester gap, E.

The same aerial is used for 300 as for 600 metres, but in the former case direct coupling is adopted, S_3, is open and S_2 is closed, and the aerial is joined through a condenser, C_2, and thence through I_4, I_3, T and E to earth. The connections between S_1 and the earth connection on D are common to the primary and aerial systems.

In this design the energy radiated on the 300 metre wave is very much less than that radiated on the 600-metre wave. The station, however, is normally designed to work on 600-metre, and the arrangement allows for resonance working on the 300-metre wave, with sufficient power on the latter to work the Great Western Railway boats, without interfering with the neighbouring stations, at St. Just and Seaforth.



A. Transformer oscillation W.T. No. 1.
B. Inductance W.T. No. 1.
C. Switch wave changing No. 1.
D. Switch wave changing No. 2.
E. Inductance W.T. No. 5.
F. Condenser W.T. No. 10.
G. Condenser W.T. No. 2.
H. Ammeter aeriel No. 1.
J. Discharger earth.
K. Insulators' mess-room No. 3.
L. Switch tumbler No. 1.

Fig. 2. Fishguard Wireless Station. Arrangement of Apparatus.

The direct current mains are led into the building and go straight to the main switch; from thence they go to the motor side of the motor alternator through a motor starter, controlled by a tumbler switch placed close to the operator.

The alternating current mains go from the alternator to a switch fitted on the power board, and from thence to the primary of the transformer, the transmitting key and iron core inductance being in circuit. The power is broken directly on the transmitting key, no electro-magnetic key being used, as difficulty was anticipated with the adjustment of an electro-magnetic key at such high frequency. The connections on the H.T. side of the transformer have already

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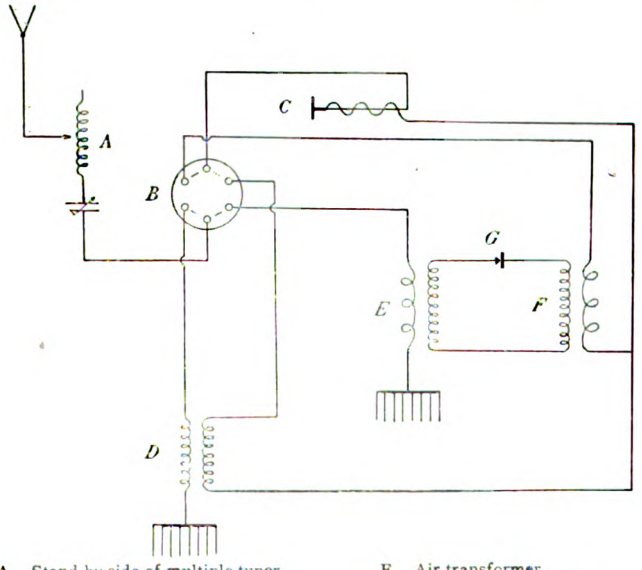
been explained, and Fig. 2 shows the manner in which the apparatus is disposed.

The mast is an ordinary three part ship's mast, 150 ft. high. It was recovered from the old Seaforth Wireless Station, and after being overhauled and repainted was erected by the Sectional Engineer at Fishguard. The anchorages are made up of bent railway metals set in concrete. They form a cheap and effective anchorage, as the rails could be obtained on the spot from the Great Western Railway Company. The stays are four $2\frac{7}{8}$ G.I. stay wire for the mainmast, four $\frac{7}{8}$ G.I. stay wire for the topmast, and four $\frac{7}{8}$ G.I. stay wire for the topgallant mast. It was originally intended to put up four cages to form an umbrella aerial, but later it was decided that the mast was not strong enough to withstand the pull of the cages in such an exposed position, and single wires were used. The aerial is insulated from the mast and the poles carrying the extension by vulcanised strop insulators.



A. Stand-by side of multiple tuner.
B. Six-terminal 2-pos. switch.
C. Telephone
D. Primary and secondary of magnetic detector.
E. Air transformer.
F. Telephone transformer.
G. Crystal detector

Fig. 3. Fishguard Wireless Station. Receiving Circuit Diagram.

The four lower ends of the wires are bunched and taken to a Bradfield insulator fixed in the wall of the building, and the inside of the Bradfield connected to the internal apparatus.

The earth consists of twenty-four plates $2\frac{1}{2}$ ft. by 5 ft. of stout galvanised iron placed vertically in the ground and bolted together to form two semicircles of 20 ft. radius. $\frac{7}{16}$ copper H.D. wires are soldered to the plates, three to each plate, the outside wire being common to two plates. The wires converge from the earth plates to a central point, and are carried above the ground and bunched at the central point. The bunched wires are fixed by means of a globe porcelain insulator to the top of a 10-ft. light creosoted pole. The two earth systems are connected together and a common wire is led into the building to the earth arrester gap. The ground at Fishguard is very rocky, and this type of earth was adopted to provide a capacity earth in addition to the ordinary earth.

The receiving gear is connected across the earth arrester gap, and consists of a multiple tuner which can be worked with either a magnetic or a crystal detector. The skeleton diagram of connections is given in Fig. 3.

It will be observed that in switching over to the crystal an air transformer is joined across the detector terminals in place of the primary coil of the magnetic detector. As the multiple tuner is designed to work normally with the magnetic detector the inductance of the primary of the air transformer is made the same as that of the primary of the magnetic detector.

Low-resistance telephones are used for both magnetic and crystal working by the aid of a telephone transformer for the latter.

Another of the stations comprised in the coast station reorganisation scheme is that at St. Just, in Cornwall, particulars of which are also given in the *Post Office Electrical Engineers' Journal*.

It was originally intended that power for this station should be derived from a high-voltage supply to the mines in the district, but as the mains were not run it was found

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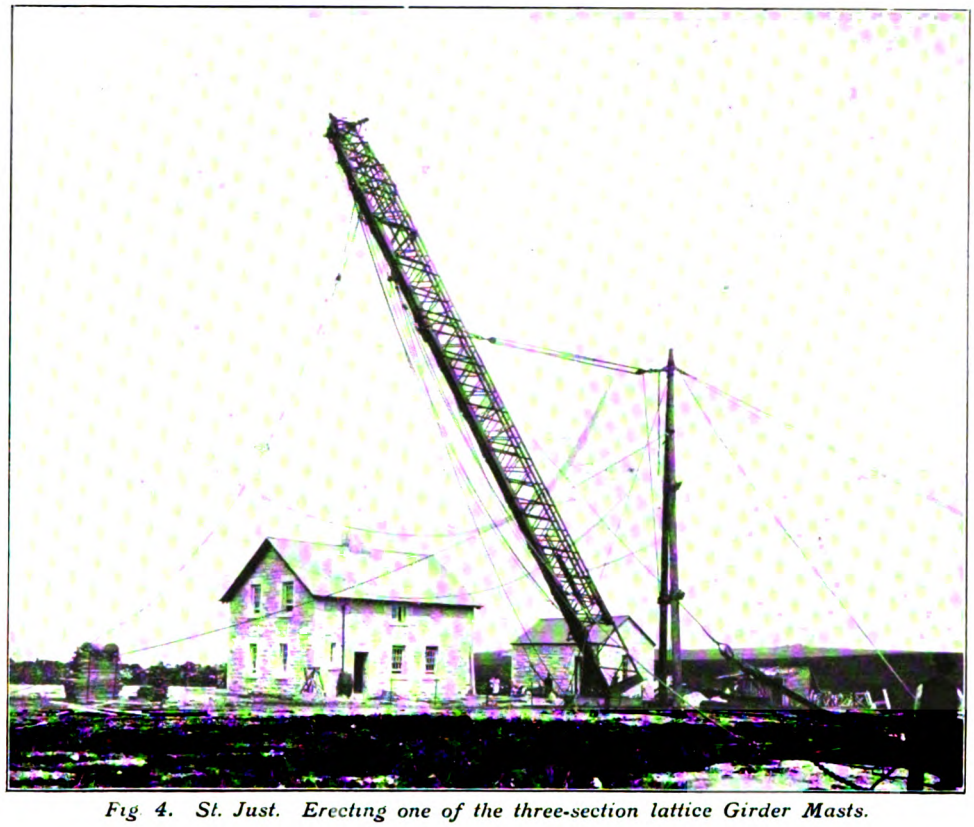

Fig 4. St. Just. Erecting one of the three-section lattice Girder Masts.

necessary to convert the transformer house into an engine and battery room, and to arrange for prime movers and batteries with the necessary accessories.

In the case of both Fishguard and St. Just the instrument room, where the operating is done, is kept well away from the power room. The motor generator is started up by a remote control switch operating an automatic starter. This assures the necessary silence during reception of messages though the motor generator may be running.

The diagram of connections and general lay-out of the internal transmitting plant follows closely the lines of Fishguard. The fundamental differences are greater power—5 kw. instead of 3 k.w.—and the provision of two aerials, one for the 600-metre wave and one for the 300-metre wave, instead of only one.

Two 200-ft. lattice girder steel masts support the aerials.

Each mast is in three sections, the sections telescoping into one another. Fig. 4 shows the three sections nearly in position.

In raising the mast an axle was fitted to one side of the mast at the base and this was mounted so as to allow the mast to rotate in a vertical plane during erection.

When the three sections were in position the two inner sections were lifted vertically to the top of the outer section and the two outside sections bolted together. The innermost section was then lifted to the top of the second section and the second and third sections similarly bolted together. The completed masts are shown in Fig. 5.

There are three sets of four stays to each mast, the stays being 2½″ steel rope.

A pulley is fitted at the top of each mast and over these run the halyards for supporting the aerial. The anchorages consist of reinforced concrete blocks.

The 600-metre aerial is triangular in shape, the base of the triangle being at the top; each side consists of a cage made of

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six wires of 7/19 H.D. copper. The two side cages are anchored down to ringbolts set in concrete in the ground.

The aerials are insulated from the mast and the ground by vulcanised strop insulators. Leads are taken from the bottom of the two legs to a Bradfield insulator fitted in the roof of the power room.

It was originally intended to strengthen the roof and to anchor the aerials to it, but this idea was abandoned. A special platform is built on the roof of the power room. The leads from the 600-metre aerial go to one of the outside insulators, and the lead from the 300-metre aerial goes to the other, the earth leads being joined to the centre one. The inside terminals of these insulators go to corresponding points of the internal apparatus.

The 300-metre aerial consists of two parallel wires 160 ft. in length and separated by wooden spreaders at the top and bottom.

The earth system consists of two sets of ten galvanised iron plates, each 6 ft. by 3 ft. arranged in two segments of a circle of 80 ft. radius having as centre the mid-point between the masts. The plates are buried as vertical as possible without having recourse to blasting the ground, which is of a rocky nature. The longer edges are placed horizontally and bolted together at the upper corners so as to form a continuous sheet. To the centre of each plate a lead of bare 100-lb. H.D. copper wire is soldered, the wire being passed in and out through three holes in the plate so as to form a good mechanical as well as a good electrical joint.

The earth leads are carried over short posts projecting 2 ft. above ground 5 ft. from the centre of each plate, and thence in a single span to a special earth bar carried on insulators on the roof platform over the high-tension room in the operating house.

A wire connecting each set of earth leads is carried to the centre insulator in the roof, the under side of the insulator being connected to the earth arrester gap. The earth bars on the platform consist of T. iron carried on third rail insulators.

The prime movers are two semi-high-speed engines, each capable of developing 10 H.P. at 800 revs. They are fitted with overhead valve gear and govern on the throttle.

In each engine the carburetter is of the

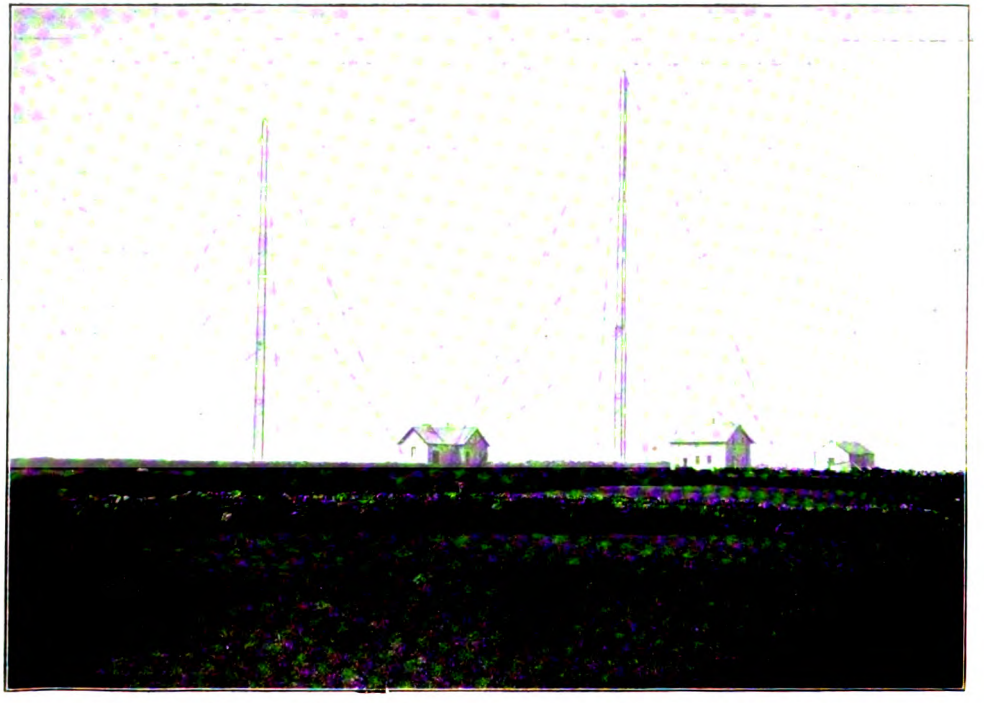

Fig. 5. St. Just Wireless Telegraph Station. The Masts completed.

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single-jet automatic type and fitted with exhaust heated vaporiser. The carburetter is arranged for a petrol start and is turned over to paraffin when it warms up. High-tension magneto ignition is employed. Each prime mover is connected to a D.C. generator designed for an output of 5 kw. at 100 to 140 volts at a speed not exceeding 700 revs. per minute. The D.C. generator charges a battery of 52 cells suitable for a discharge of 378 ampère-hours at the 9-hour rate. The battery supplies energy to a motor alternator; the motor is 100 to 140-volt compound wound of sufficient power to drive the alternator and disc discharger; the alternator is designed to give a single-phase current at 300 volts, 200 periods per second and a total output of 5 kw. at unity power factor. Spare armatures are provided for all the machines.

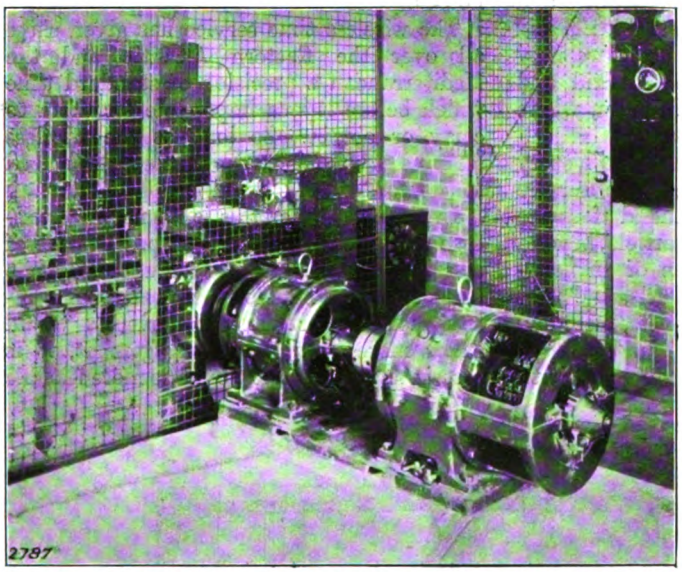

Fig. 6. St. Just Wireless Station Motor Alternator fitted with Rotating-disc Discharger and High-tension Apparatus.

With regard to the receiving set in conjunction with the multiple tuner, either a magnetic detector or crystal detector may be used. The arrangement of the air-transformer, with a split secondary winding having the telephones at the split and the crystal detector across the outer terminals, was suggested by Mr. J. E. Taylor, and follows the arrangement used for coherer jiggers. This set has, however, only been installed temporarily, and will be superseded later by a standard set as at Fishguard.

In tuning up the station and testing with Crookhaven, 200 miles west, the signals were given: "Clear as a bell and very strong." A boat, 300 miles west, gave the signals as strong. It is impossible to say exactly at present what the range of the station is, but it is considerably in excess of that of Fishguard.

The following is a list of the stations which comprise the Post Office scheme:—

CULLERCOATS.

NORTH FORELAND.—The power plant to be duplicated and the existing apparatus improved.

NITON.—A new station to be built to replace the existing one and the power to be increased from $\frac{1}{4}$ kw. to $1\frac{1}{2}$ kw.

LIZARD.—A new station to be built at St. Just to replace the Lizard, and the power to be increased from $\frac{1}{4}$ kw. to 5 kw.

ROSSLARE.—A new station to be built at Fishguard to replace the Rosslare station and the power to be 3 kw. instead of $\frac{1}{4}$ kw.

MALIN HEAD.—A new station to be built to replace the existing one and the power to be increased from $\frac{1}{4}$ kw. to 5 kw.

VALENCIA.—A new 10 kw. station to be built on Valencia Island.

A musical note is provided for the last five stations, the spark frequencies being 300, 400, 300, 400 and 600, respectively in the order given.

Malin Head will follow closely the design of St. Just, but there will be only one mast and one aerial instead of two.

Malin Head, Valencia, and Niton Wireless Stations will be completed early this year.

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A Time-Signal Receiver

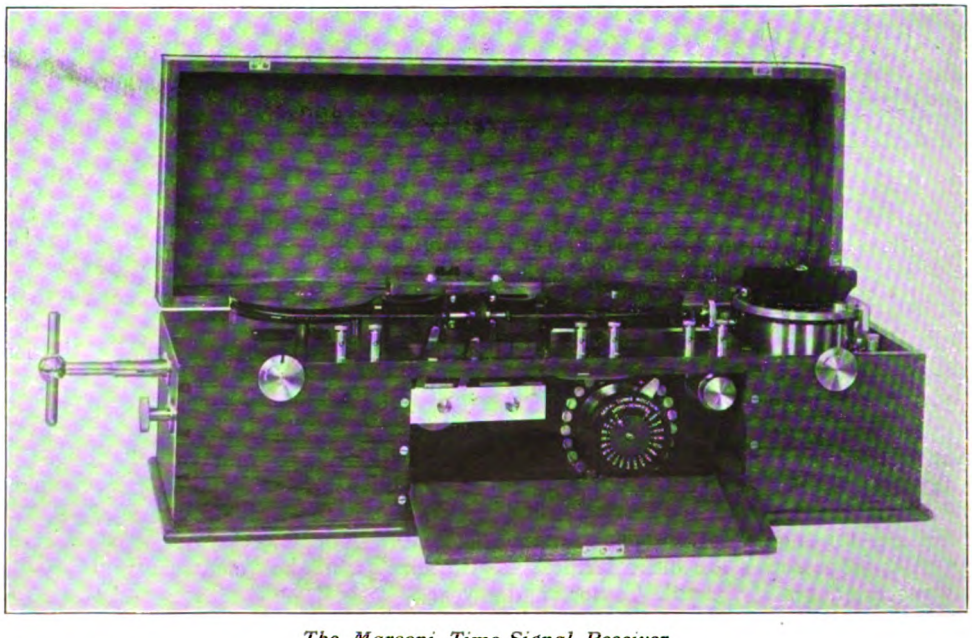
IT will come as welcome news to a great many readers of this magazine that there is now available a complete Time-Signal receiving set which is manufactured in the Marconi Works at Chelmsford. The type which is here described has already been supplied to a number of "amateurs" and others who wish to receive time signals, and among the most prominent users we may mention the observatories of Madrid and Ucele, the latter a town in Belgium, where the Royal Observatory is situated.

We need not here enter into the history of the establishment of the time service which has created the demand for the apparatus we describe in this article, beyond saying that it is the outcome of an international conference held at Paris, and that it has been welcomed by scientists, including the Astronomer Royal.

These signals will be of great value both to clock and watch makers and to astronomers and owners of observatories, while it is hoped by many that their use will be found so simple that an apparatus for receiving them will become part of the equipment of every village and of many country houses.

The wireless time service has given ships all over the Eastern Atlantic and the Mediterranean a precision of standard time which before it was impossible for them to carry or obtain. So long as the wireless remains at work the chronometer is relegated to the position of a stand-by.

In times of peace this is no mean advantage to the security of the ship. In time of war it may well prove invaluable. While there may be some doubt whether the wireless receivers or the chronometers would suffer more in a naval engagement, it is certain at least that it would be more feasible



The Marconi Time-Signal Receiver.

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to re-establish the wireless than the chronometers. Moreover, a ship beyond the range of wireless time signals—if such a thing be possible in the near future—is able to exchange its knowledge of Greenwich time with any ship in range. Wireless has played a spectacular part in mitigating disaster at sea; it seems destined in the future to play the better part of preventing it, by ensuring that a ship need never be in doubt about its longitude. These advantages are not now exclusively enjoyed by ships, for, with the Marconi Time-Signal Receiver, it is just as simple a matter to receive the signals on land as it is on board ship. Indeed, the work of the Brazil-Bolivia Boundary Commission described in the December number of THE WIRELESS WORLD, and referred to again in this issue under "Notes of the Month," furnishes a striking illustration of the use to which the apparatus may be put and the advantages accruing from its use.

There can be no question, therefore, as to the need for the Marconi Time-Signal Receiver. The apparatus has been carefully designed and constructed, and in every respect well maintains the high standard of all apparatus manufactured at the famous Chelmsford works.

It is an entirely self-contained apparatus, the detector, tuning condenser and inductance being mounted in the same case, which measures 1 foot 10½ inches by 7¾ inches by 8¼ inches over all.

The magnetic detector consists of a soft iron band moving at a uniform rate in the magnetic field provided by two permanent magnets; this band passes through a glass tube carrying a primary winding connected to the aerial circuit through terminals, while a secondary winding connected to the head-gear telephones is carried on an ebonite bobbin placed over the centre of the primary. The band is composed of a large number of strands of fine gauge silk-covered soft iron wire, loosely twisted together, and covered with vaseline; it passes as an endless band round two ebonite pulleys—one driven by clockwork in the base of the instrument, and the other running free.

The arrangement of primary and secondary windings with their corresponding terminals is duplicated on the receiver, so that in the event of damage to the windings on one side the opposite set can be employed.

A hinged lid is fitted on the case to protect the band, windings and other external parts from dust or breakage.

The aerial tuning inductance comprises a solenoid winding of insulated wire with tappings leading to a controller switch with 21 contacts, giving a wide range of finely graduated adjustment. The tuning condenser is of the disc pattern, giving continuously-variable adjustment over the range of capacity required.

The method of connecting up and using the instruments is very simple. It is necessary to point out that the receiver should not be connected directly to the aerial when the aerial is also being used for transmitting; in such cases it should be connected by a suitable switch.

The range of wave-lengths received on this instrument is approximately from 100 to 2,500 metres, but the limits of this range will vary with the aerial installed, the minimum wave-length received by the detector being a little more than half the fundamental wave-length of the aerial.

Another form of this apparatus which will be even cheaper than that described will be ready shortly.

The *Financial Times* is informed by the Canadian Government Emigration Office that when the new chain in wireless stations, now in course of construction by the Canadian Government, is finished and in operation it will be possible for a passenger on any incoming steamship to communicate from mid-ocean as far inland as Fort William. In connection with supplementing the service the wireless station on the Tarte Pier is to be newly equipped with apparatus having a longer range. All down the river and gulf the Government stations are in regular operation, while the new ones being built at Toronto, Kingston and Port Burwell will soon be completed, and the latter will be in operation during the winter. With eight powerful stations on the Great Lakes operating in conjunction with those at Montreal, Quebec and on the sea, the wireless system on Canadian waterways will thus be complete and second to none in range and efficiency.

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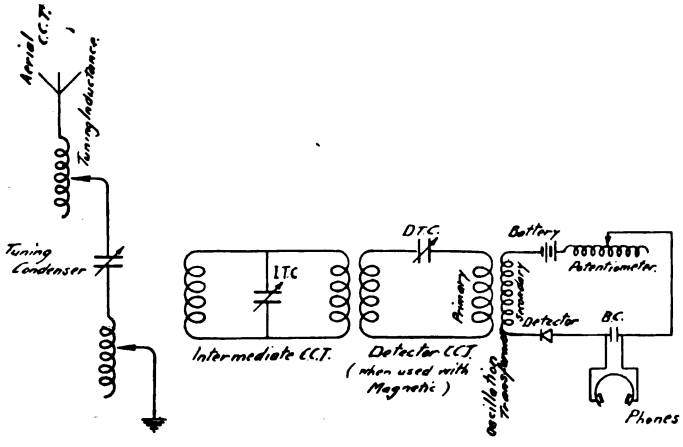
Practical Problems

On Tuning.

"SYNTONY," writing from the s.s. *Chagres* in the Caribbean Sea, on October 21st, states: "The communication which you published in your October issue, signed 'Operator,' interested me very much. To supplement his experience I may remark that by using an oscillation transformer in conjunction with the multiple tuner and a crystal detector I have obtained



very good tuning. The multiple tuner is connected to aerial and earth as usual. The two middle terminals of the tuner, which are usually connected to the primary of the 'magnetite,' are connected to the primary of the oscillation transformer. The secondary of the oscillation transformer is connected as usual. The best value for the jigger primary is soon found by adjusting till signals are strongest, and when found needs very little adjusting. By using the 'tune' side of the multiple (making full use of the intensifier handle) and loose coupling the jigger, jamming even at night can be very nearly overcome, and X's 'come in' no stronger than they would on the magnetic.

"As an example:—In working Bowden, Jamaica, the signals of s.s. *Prinz Auguste Wilhelm* could be completely 'tuned out,' although this could not be done on the magnetic detector working with the multiple tuner. (D S B was much nearer than Bowden.)"

* * *

Checking Chronometers.

Mr. A. W. Wyett writes from the *Mooltan* as follows: "Allow me to report a novel occurrence, which I think is the first on record. When off Cape Guardafui, the captain of the Shaw, Saville & Albion s.s. *Waimana* sent an M S G for G M T. The following was adopted to transmit same to him. A fixed time was sent across to the *Waimana*, whose second officer 'stood by' his chronometers, and the operator was standing by, waiting for me to send the word 'stop.' Our second officer gave me a minute's warning, and on the stroke of the aforesaid fixed time I sent 'stop.' This was repeated, and both times was highly successful. As the *Waimana* was at sea for 18 days without a time ball it was a valuable check on her chronometers."

* * *

Atmospherics.

In the October number of THE WIRELESS WORLD there appeared a communication on this important subject, which has brought us the following remarks from R. A. S. Writing from Basreh on November 9th, 1913, he states:

"I should like to contribute my experience in the Persian Gulf. During six months' observations I found that the conditions here are more varied than those mentioned by W. P. S. Whilst lying at Busreh, I noticed that the strength of signals of the station at Jask (bearing S.E. by E. from Busreh) would be strong enough to read with the telephones 2 feet away for a period of about one minute, then decrease until signals were inaudible for a period of about

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a minute, increasing again until signals were strong, during which time I also noticed that the strength of signals of Port Said remained constant. (Port Said bearing W. by N. from Busreh). I also noticed at times that the strength of signals from both stations would increase and decrease simultaneously, whilst at other times the conditions were similar to those mentioned by W. S. P., during which time the strength of signals from ships in the Red Sea remained constant. At first I thought it must be due either to the hot or damp winds experienced during the hot weather, but since the cool weather has set in the same conditions occur, as they do also when the atmosphere is dry. I do not see how it can be the ether surging, as I have known signals to be inaudible for an hour or more then increase to strong signals from the above-mentioned places simultaneously. I hope this information may be of some value to all who may be interested in the investigation of the phenomena of such conditions."

* * *

Mr. W. P. Spurgeon writes to us as follows: "In the October number of THE WIRELESS WORLD you kindly published a letter from me in which I suggested that there may exist some relationship between the variations in solar phenomena and the conditions of the earth's atmosphere for wireless purposes. In the November number Dr. Eccles remarks: 'There is nothing unreasonable in supposing that the sun, let us say, may send us occasional electric waves,' and goes on to add that electric discharges may be produced in the formation and collapse of a solar prominence of sufficient magnitude to create waves which would affect a wireless receiver, thus forming a proportion of our strays. It was not exactly in that light, however, that the idea had presented itself to me. It has long been an observed fact that the variations in solar phenomena—sunspots, faculæ, prominences and the corona—correspond very closely with the earth's magnetic and electrical variations, and also with the auroral displays, though the exact nature of the connection still needs to be discovered. It seems therefore quite probable that the link which obviously exists between the sun and the earth in those respects should also exist in respect to atmospheric conditions as affecting radio-telegraphy. This supposition was recently supported by a short notice in one of the daily papers on Dr. Mawson's expedition. It was stated that the station at Macquarie Island experienced the greatest difficulty in communicating with Hobart when the auroral displays were most intense—at times finding communication quite impossible. It was not stated whether the difficulty was due to strays or a weakening of the received signals—an interesting point. Of course, the difficulty may not have been due to the auroræ directly, but possibly to some accompanying phenomena. It is just conceivable that the auroral discharges (if the term is permissible) may produce electric waves which would affect a wireless receiver; but as they are more in the nature of the glow of a vacuum tube, it is not very probable—though, as I say, just possible—that anything in the form of oscillations would be produced. However, these are the points which need observation and not mere supposition.

"The investigation of the causes of the variation in the strength of received signals will probably be more difficult than that of atmospherics, for the former phenomenon is of a momentary character, and often only observed while receiving from another station, when it would be difficult accurately to record the changes; while the latter, much to the annoyance of the operator, affords plenty of time for detailed observation. In my former letter I remarked that the variation in signal strength gave the impression of a rapid motion of the ether. Of course, it was only an impression, as any motion sufficient to affect signals in that way would at once betray itself in causing a variation in light waves—a variation not discoverable in optical measurements. It is quite probable that the effect is due to a bank of ionised air passing between the stations, and by its reflecting a portion of the wave energy reducing the received energy to a greater or less extent, proportional to the degree of its ionisation. Here, again, observation is needed.

"One is very pleased to note that such bodies as the Admiralty, the Post Office, and the Marconi Co. will be assisting the investigations of the B.A. Committee. As Dr. Eccles says, one will be surprised and disappointed if some interesting and valuable data is not shortly forthcoming, and an announcement by the Committee as to the line of investigation is eagerly awaited."

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NOTES OF THE MONTH

GREETINGS BY WIRELESS. DETERMINING LONGITUDE BY MEANS OF WIRELESS. RADIO-TELEPHONY AND TELEPATHY. TRAINING OF TERRITORIALS. THE SHARE MARKET.

AT the New Year we always expect to receive some report of the part wireless telegraphy has played in the season's festivities, and as usual we were not disappointed, though the information reached us too late for publication in the last issue of THE WIRELESS WORLD. As was to be expected this effective method of sending greetings was largely utilised by those who had friends at sea; and only those who have been forced to make a voyage at a time which is usually given up to family reunions and convivialities can realise the delight which such messages bring to their recipients. They were more numerous than ever this year, and have easily established a record.

* * *

News was received in London early last month from the Bolivian Survey Commission, dated Abuna River, November 25th, announcing the fact that Commander Herbert A. Edwards, the officer who was lent by the British Government for a period of three years, to command that Commission, has once more reached civilisation and completed over 200 miles of frontier survey. Commander Edwards and his party, whose duty was to survey mostly unknown country, the disputed frontier between Bolivia and Brazil, had travelled up the Abuna River to a settlement called Santa Rosa, whence they cut across country to meet another section of the Commission. Both parties then returned down the Abuna on the completion of the survey. The work of the Commission was described in the December number of THE WIRELESS WORLD, and the interesting fact which we are now able to announce forms a useful supplement to that article.

* * *

The great achievement of the expedition is that they fixed all their longitudes by time signals sent by wireless telegraphy from the Marconi station Porto Velho, situated 120 miles from the base of operations. A party was left at Porto Velho, and, by the courtesy of the Brazilian Government, time-signals were sent every night. Commander Edwards carried with him a receiving set and a long wire, which was rigged up on trees. He has proved that wireless telegraphy will enable the explorer to dispense with chronometers, and easily and accurately fix all longitudes. Commander Edwards says this will begin a new era in exploratory surveying. He eulogises the work of a wireless expert, Mr. Chapman, who laboured night and day to make the experiment successful. In the course of his work this gentleman had terrible experiences with hornets, ants, and other pests. He was provided with climbing irons on his legs in order to ascend the highest trees. The Commissioners have still to erect boundary marks along a portion of the frontier, but the commencement of the rains will render it impossible to deal, this year, with a section of forty miles of frontier which it was hoped would be covered during the present season.

* * *

Mr. Burton F. Babcock, of Syracuse, New York, has called attention in the *Electrical World* to what is described as "some interesting original observations concerning radio-telephony." He states: "I believe it has been my good fortune to make a discovery in wireless electricity which will astonish the civilised world when it has been thoroughly tested. A few hundred volts of wireless, controlled into small, strong continuous current only a few inches in diameter, will not only convey sound in the form of ordinary conversation, but will transfer thought from brain to brain. When accustomed to this method of communication a conversation can be carried on at a distance of several miles without any audible sounds whatever. Bodily pain

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inflicted on one person in the current is instantly felt by the other to almost an equal extent. Please notify some expert electricians in order that all may learn its possibilities." In publishing this extract from our contemporary, we have only one comment to make. There are many who believe—and who shall say that they are indubitably wrong?—that the next great discovery in science will have to do with the correlation of the theory of wave-motion and the scattered facts of telepathy. We do not scoff at them or their belief; but neither we, nor they, will be disposed, we think, to feel that the great tidings for which they wait have come from Syracuse, New York.

* * *

Paris and Washington are 279 feet farther away from one another than they were a year ago, or at any rate than they were believed to be a year ago. Such appears to be the net result of the attempts made by MM. Renaud and Bourgeois and the calculators of the French and United States Naval Departments to arrive at a new and more precise determination, by the aid of wireless telegraphy, of the difference in longitude between Paris and Washington. The radio-telegraphic messages were sent out respectively by the wireless stations at the Eiffel Tower and at Arlington, U.S.A., between which is a distance of 6,175 kilometres, or approximately 3,860 miles. From each station 300 signals were sent out, spaced at time intervals varying from 1 sec. to one-one hundred and twentieth of a second. Out of twelve trials to effect this interchange of messages three were quite useless, five were fair, and two only, the series sent on March 28th and on April 1st, were completely satisfactory. The time of the double transmission between the two stations, the round trip, as the Americans would say, was estimated as either 0.066 sec. or 0.063 sec., and the latter of these figures was accepted as the more accurate.

* * *

A report appears in the Press that it is proposed to hold a conference at the War Office with a view of formulating a scheme for the efficient training and practice of wireless telegraphy detachments of the Territorial Force. If the report is correct it certainly marks a step in the right direction. In developments of this kind the Territorials frequently go ahead with an enthusiasm backed up by genuine scientific attainment. This is perhaps peculiarly the case with wireless, in connection with which several corps have equipments. The Royal Engineers may justly claim to have kept themselves well abreast of the latest developments in this direction, but between this and controlling the progress of the Territorials—many of them very advanced students in this branch—there is a distinction with a difference which the War Office has done well to recognise. A satisfactory result of the proposed conference would be the elevation of Territorials really proficient in wireless to some sort of special position as instructors instead of allowing them to continue to some extent *in statu pupillari*. Meanwhile attention may be drawn to the announcement which appears on another page regarding the examination which we propose to hold for those members of the Territorial Forces who have followed the series of instructional articles that have appeared in this magazine during the past months.

* * *

That magnificent gift of the Colony of New Zealand to the Mother Country, in the shape of a battle cruiser for service in the Imperial Navy, recently made a short stay at Port of Spain, Trinidad. Wireless news was received two days before she was due announcing the date of her arrival, and she duly dropped anchor to the very minute advised. The people of Trinidad were not lacking in their appreciation of the visit, and the following wireless message from the captain of the *New Zealand*, received by the Governor after the vessel's departure, is an acknowledgment of Trinidad's efforts: "Good-bye; we leave Trinidad with regret after a most delightful stay, and we are all most grateful for what has been done for us."

The Share Market.

January 21st.

There has been a decided recovery in the Marconi Share market due to a better state of stock markets, and also to the Convention signed by the Maritime Powers with reference to a more universal use of wireless installations on ships.

Closing prices to-day are:—Marconi Ordinary, £3 17s. 6d.; Marconi Preference, £3 2s. 6d.; Canadian Marconi, 9s. 6d.; Spanish and General, 11s. 3d.; American Marconi, £1 1s. 3d.; Marconi International, £1 11s. 3d.

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Maritime Wireless Telegraphy

DURING the winter months fresh records of disaster and rescue-work are always added to the annals of the sea; but it is comforting to learn that the percentage of life saved is continually on the increase. As a matter of fact, such a statement errs on the side of an underestimate, for it is not too much to say that this percentage has increased by leaps and bounds since the advent of wireless telegraphy, and the more widely this great safeguard is adopted the greater will be the increased security of those travelling by sea. Two particular instances of its efficacy have recently come to the notice of the public—the one is the rescue of the steamship *Tasman*, the other is that of the oilship *Oklahoma*.

* * *

On Monday, December 29th, news came through to the wireless station at Melbourne that the *Tasman*, a passenger vessel trading between Australia and Batavia and belonging to the Koninklijke Paketraart Maatschappij, had run ashore near Bramble Bay in the Gulf of Papua. She was in a dangerous position, her bottom ripped up on the jagged points of the sunken reefs which make this part of the coast particularly difficult to navigate, and the message went on to say that there was already fifteen feet of water in the hold, and that it was gaining rapidly. As soon as the information was received it was distributed broadcast to the ports, and as a result a Japanese steamer left Thursday Island without delay and raced under full steam to the assistance of the disabled vessel.

* * *

By this time the heavy seas which had been raging were somewhat abated, so that the rescuing vessel was able, after many strenuous attempts, to get the *Tasman* safely off the reef, when it was found that, though badly damaged, she might yet be able to finish the journey under her own steam; this she did, and safely reached Soerabaya, her ultimate destination. The adventure, which, to the gratification of everyone, terminated so happily, was of particular interest to the public owing to the fact that the celebrated prima donna, Mme. Nordica, was on board the *Tasman*.

* * *

The first news of the wreck of the *Oklahoma* was received in New York on Sunday, January 4th, when a wireless message came through from the Spanish steamer *Manuel Calvo* that a steamer with some undistinguishable name was sinking to the south of Nantucket. The difficulty of identifying the vessel caused the gravest anxiety, for she reported that the *Oklahoma* had already lowered lifeboats, which had been swamped, and the *Manuel Calvo* was unable to render any assistance, although she was standing by. But the exact state of affairs came to light a few days later when the British freight steamer *Gregory* reached New York with five of the crew of the *Oklahoma* aboard. They were found in a small boat on Sunday afternoon a few miles from the scene of the disaster.

* * *

The survivors told a harrowing story of hardship and suffering. The *Oklahoma* was struck early on Sunday morning by a gigantic wave which broke her in two. Many of the men were asleep in their berths, when a crashing and rending sound warned them that disaster had overtaken the ship. They rushed on deck to find the after half of the vessel sinking, with the propellers whirling high in the air. The two boats were thrown rather than lowered into the sea, and into these the majority of the crew of 32 sprang. By a miracle they escaped being cut to pieces by the screw, which a few moments later plunged beneath the seas with the rest of the stern half of the steamer. One of the boats, containing 11 men, capsized. It righted, however, and six men succeeded in climbing into it. They kept the boat floating by baling the icy water with their hands until the afternoon when they were sighted and rescued by the *Gregory*. The second boat was picked up by the revenue cutter *Seneca*. It contained three bodies only.

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Captain Gunter, of the *Oklahoma*, and seven other survivors were taken on board the Hamburg and American freighter *Bavaria*, and reached Boston safely on January 7th. They were only rescued in the nick of time, for the forward part of the hull of the wrecked tanker on which they had taken refuge was on the verge of sinking, and the whole of the evidence goes to prove that their ultimate safety is due entirely to the services rendered by wireless telegraphy, for although the *Calvo* did her level best to help the crew of the *Oklahoma* she was powerless to effect rescue, for this could only be achieved by the more powerful ships which she summoned by her wireless, and, as reports show, these arrived not a moment too soon.

* * *

Even as we go to press the report has come through of another maritime disaster during the recent storms. On January 13th the Royal Mail steamer *Cobequid* ran aground on the sunken Trinity reefs, near Yarmouth, just at the entrance to the Bay of Fundy. It appears that the vessel lost its bearings in a blizzard and struck the reef at 5 a.m. on Tuesday morning (January 13th). Immediately, Captain Lawson, the commander of the *Cobequid*, ordered the wireless operator to send out the S.O.S. signal, which was received by the wireless station at Cape Sable, whence the message was distributed broadcast. It was immediately received by the *Kronprinzessin Cecilie*, and on its receipt the vessel went to the aid of the distressed ship. Some difficulty, however, was experienced in finding her, owing to the fact that the *Cobequid* was 100 miles out of her bearing. In the meantime other vessels engaged in the search, notably the *Belvedere*, which at the time of receiving the news was making her way from Belfast to New York, while the Government steamer *Laurier*, another, the *Lansdowne*, and two tugs besides the Revenue cutter *Woodbury* (which was cruising 100 miles away) joined in the search. A little later the coastal steamers *Westport* and *John L. Cann*, also put out. When the *Cobequid* was reached she was found still clinging to the ledges, but there was a large hole in her stern, and terrific seas were sweeping over her. The inrushing water had disabled the engines and stopped the working of the dynamos, while the vessel was sheathed in ice. Soon other vessels came within sight, including the British steamer *Rappahannock* (which helped in saving the survivors of the burning steamer *Volturno* in mid-Atlantic in October last) and the steamship *Aberdeen*.

J. W. Hitchner, Senior Wireless Operator on board s.s. "Cobequid"

* * *

As soon as the violence of the storm had abated somewhat the work of rescue commenced, the *Westport* and the *John L. Cann* taking the most active part, while the other vessels stood round so as to act as a breakwater against the high sea. While those on board the *Cobequid* were being lowered by ropes into the lifeboats, the most dextrous handling was required to prevent such small craft being capsized. The first boatload left for the rescuing steamers at seven o'clock on Thursday morning (January 15th), and by 7.30 all had been taken aboard the ships, except the captain and eleven of the men who elected to remain in the hope that they might save some part of the cargo. Later in the day, however, they, too, were taken off by the s.s. *Aberdeen*. Of the total number of passengers and crew, the *Westport* saved seventy-two and the *John L. Cann* twenty-four. Thus ends happily the tale of one of the most exciting and difficult of rescues in the annuals of the sea, which, but for the services of wireless telegraphy, could never have been achieved. How else could the search have been instituted for the lost vessel, or so many sister ships have responded so quickly and efficiently to the call for aid ?

Mr. Ernest Shrimpton, Junior Operator s.s. "Cobequid"

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Contract News

Marconi's Wireless Telegraph Company are fitting the steamship *Prudente* (call letters SRV) belonging to the Lloyd Brazileiro line with a 1 kw. set. The vessel is engaged in the Brazilian coastal trade.

* * *

Standard ½ kw. ship sets with emergency gear have been installed by the Marconi Wireless Telegraph Company of Canada, Ltd., on the *Lurcher* lightship and the Fisheries Protection cruiser *Simcoe*. Both vessels belong to the Canadian Government, and additional interest is given to the announcement by the fact that one of the first tasks that the installation on the *Lurcher* was called upon to perform was to assist in the rescue of the steamship *Cobequid*, which on January 13th ult. ran ashore on the Trinity Ledges, which guard the entrance to the Bay of Fundy, where the *Lurcher* is stationed. The call letters of the *Lurcher* are VDR, those of the *Simcoe* VDS.

* * *

Messrs. Holliday Bros., of Quebec, have arranged for the installation of a 1½ kw. and emergency set on their steamship *Aranmore* by the Marconi Wireless Telegraph Company of Canada.

Orders have been received by the Société Anonyme Internationale de Télégraphie sans Fil to equip the following Vessels:—

Name of Vessel.	Owners.
Arakan	Rotterdamsche Lloyd
Djember	" "
Insuluide	" "
Jacatra	" "
Banka	Stoomvaart Maatschappij Nederland
Baweau	" " " "
Boeroe	" " " "
Prins der Nederlanden	" " " "
Riouw	" " " "
Roepat	" " " "
Rondo	" " " "
Rotti	" " " "
Francoli	Linea Tintore (Barcelona)
Torre-Blanca	" " "
Tubantia	Koninklijke Hollansche Lloyd
Guine	Empreza Nacional de Navegaçao
Witte Zee	Smit Sleepdienst
Zwarte Zee	" "
Statendam	Holland Amerika Lijn
Noordwijk	Erhardt and Dekkers (Rotterdam)
TJI Kembang	Java China Japan Line
TJI Sondari	" "
Colgate	W. Wilhelmsen (Toensberg)
Shoss	" " "
M. S. Elbruz	Société Anonyme d'Armement d'Industrie et de Commerce
Rotterdam	The American Petroleum Company

The following Vessels have been equipped by the Debeg Co.:—

Name of Vessel.	Owners.	Type of Installation.	Call Letters.
Thessaloniki	National Steam Navigation Co. of Greece	1½ kw. and emergency	SVK
Frederick VIII.	Det Forenede Dampskibselskab	" "	—
Werdenfels	Hansa Line	" "	DWF
Marksburg	" "	" "	DMU
Kattenturm	" "	" "	DNT
Arensburg	" "	" "	DAG
Stolzenfels	" "	" "	DOE
Delphia	D.A.P.G.	" "	DPH
Italia	Kunstmann Line	" "	DJL
Pfalz	Lloyd Line	" "	DPA
Bolama	Empreza Nacional de Navegaçao	½ kw. and emergency	CSO
Loanda	" " "	" "	CSL
Funchal	" " "	" "	CSF
Sitges	Sitges Freres	" "	EFS

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La Compagnie Française Maritime et Coloniale de Télégraphie sans Fil has received orders to equip the following vessels :—

Name of Vessel.	Owners.
Antilles	La Compagnie Générale Transatlantique
Haiti	
Puerto-Rico	
Saint Dominque	
Duc d'Aumale	
Martinique	
Moise	
Ville de Barcelone	
Ville de Bone	
Ville de Madrid	
Ville de Naples	
Ville d'Oran	
Ville de Tunis	
Amiral Villaret de Joyeuse	La Compagnie des Chargeurs Réunis
Amiral Rigault de Genouilly	
Amiral Sallandrouze de Lamornaix	
Amiral Troude	
Augo	
Bougainville	
Champlain	
Dupleix	
Ceylan	
Malte	
Ouessant	
Theodore Mante	La Compagnie de Navigation Mixte
Corsica	La Compagnie Fraissinet
Corte II.	
Golo	
Iberia	
Italia	
Liamone	
Numidia	
Anatolie	La Compagnie de Navigation Paquet
Ionie	
Medie	
Mingrelie	
Phrygie	

The following vessels have been equipped with Marconi apparatus since the last issue of this Magazine :—

SHIPS FITTED WITH 1½ KW. AND EMERGENCY APPARATUS.

Name of Vessel.	Owners.
Salamis	Andrew Weir & Co.
Barneson	" "
Highland Enterprise	Nelson Line
Highland Heather	" "
Westmeath	New Zealand Shipping Co.
Calgarian	Allan Line
Chinkoa	British India Steam Navigation Co.
Palermo	P. & O. Line
Llanstephan Castle	Union Castle Line
Star of Victoria	J. P. Corry & Co.
Crown of Toledo	Prentice, Service & Henderson
Patrician	T. & J. Harrison
San Fraterno	Eagle Oil Transport Co., Ltd.
San Eduardo	" " "

SHIPS FITTED WITH ½ KW. AND EMERGENCY APPARATUS.

Moto	Pelton Steamship Company
Linnet	Liverpool Salvage Association
Filey	Hull Steam Fishing and Ice Co.
Bempton	" " "
Potaro (refit)	Royal Mail Steam Packet Company

A ½ kw. and emergency set has also been installed in the South Wales Wireless College, Cardiff, belonging to the Northern Wireless Schools, Ltd.

The New Lightship "ALARM" now in position on the Mersey Bar Station. She has a light of 40,000 candle-power and is fitted with a Wireless Installation and a Submarine Bell. A Wireless Installation has also been erected at the Dock Office to place both the Bar and the Formby Lightship in communication with the Dock Office Building.

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CARTOON OF THE MONTH

WIRELESS WORRIES—II.

A Shipwrecked Boat's Crew attempting to send an "S.O.S." Message with the Emergency Gear.

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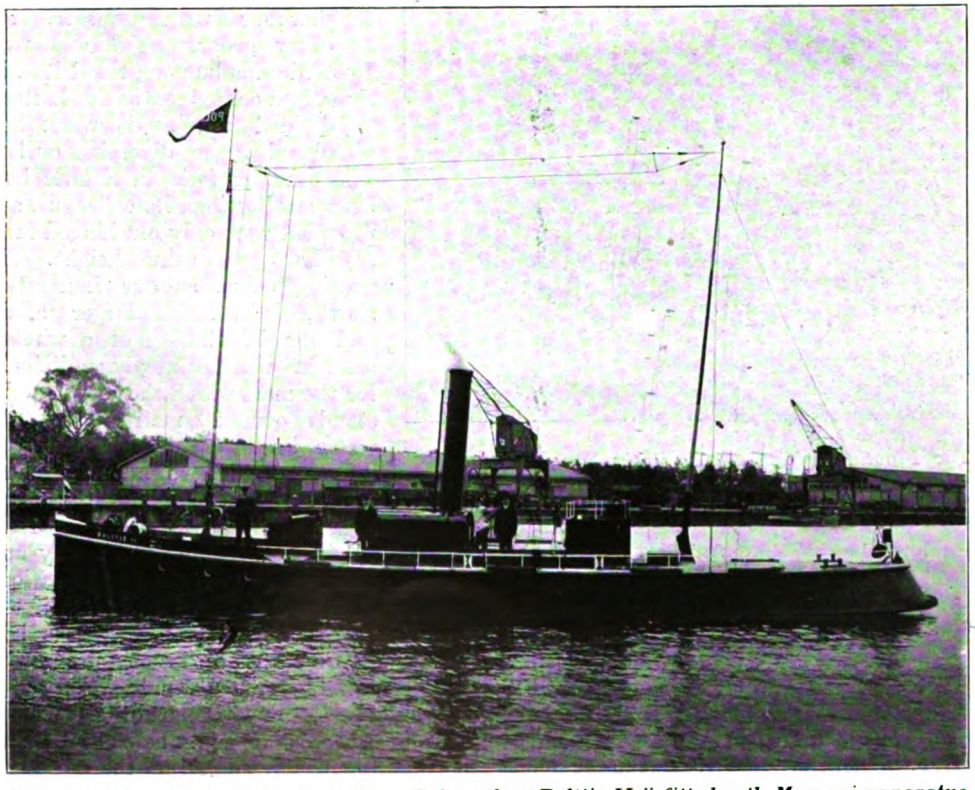
A Successful Venture in Wireless Telegraphy by the Rotterdam River Police

SOMEHOW it seems disrespectful to think of Holland as a country which harbours thieves and vagabonds. To the popular imagination it is flat and green, with many canals and streams traversing the country, and here and there a windmill, while the people are a placid and contented race, clothed, according to their sex, either in baggy trousers or voluminous petticoats, some of them smoking huge cigars or mammoth pipes. But the recent notice which the Rotterdam police have brought upon themselves by their enterprising venture into wireless telegraphy has tended to dispel that illusion. Rotterdam police. What are they there for ?

It must needs be that where police are required there wrongdoers and lawbreakers exist, but they will be cute folk who will elude these vigilant agents of the Dutch law, and if they succeed in doing so, they will ymerit their freedom, for the fact that the have escaped justice will show them to be extremely clever knaves.

This prologue has been inspired by an account which we have received of the suc cessful installation of wireless telegraphy on two of the small boats and on the floating



The Steamboat of the Rotterdam River Police, the "Politie II.," fitted with Marconi apparatus

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offices of the Rotterdam river police. The task was undertaken by the Société Anonyme Internationale de Télégraphie sans Fil, although, owing to the nature of the requirements, the work was of no little difficulty. Everything has gone smoothly, and the latest reports show nothing but praise as regards the working of the apparatus. The reason for its installation was the fact that the work of the police in this large harbour

The Floating Office of the Rotterdam River Police with the Electric Motor Boat, "Politie I.," in the foreground—both fitted with Wireless.

was considerably impeded by the amount of time wasted in the transmission of information and in waiting for instructions from headquarters. Now the boats can make their way to any part in the harbour, and either send information by wireless to headquarters and receive instructions, or they could be called up at any moment to take a part in some of the many plans which are set on foot and which require instant carrying out. The chief difficulty in the installation of the wireless was not so much that of distance, for the maximum amount of range required was about 10 kilometres, but in the need there was to overcome any obstructions which might happen to lie between any two of the vessels, such as buildings, large steamers, bridges, etc., and another necessity was to prevent any interference from the high-power stations in the neighbourhood. Perhaps the intricate nature of the work will be understood when the class of vessel in which the installations were installed has been described. The two police boats are very small. One is a motor boat about 20 metres in length, provided with two hinged masts 10 metres high, the distance between them being also 10 metres. The idea of the hinged mast is obvious, namely, in order that the vessels may be able to pass under the arches of the low bridges which connect one part of the harbour with another, for, as every geographer knows well, Rotterdam is built on the delta of a river, and consequently the harbour is divided up, as it were, into sections by the diverging outlets. The other craft is an electric boat even smaller than its colleague, and provided with only one hinged mast of about the same height. The floating office, as our illustration shows, is a much larger affair, and the installation of a wireless set here was not nearly so difficult, for the mast which the office carries stands over 20 metres above the water line. On all three vessels it was decided to adopt a short range apparatus, and the wave length in each case was from about 80 to 100 metres. In this way any possible interference with the larger stations was avoided, and it was found that if the receiving and transmitting apparatus had been slightly readjusted that communication could be established and would work well—it did not matter in what part of the harbour any of the three craft might be. The S.A.I.T. may well be congratulated on the successful solution of a somewhat difficult problem.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

For Synopsis of the Characters in this story, see previous issues of Magazine.

CHAPTER XI.—(*cont.*)

A KINGDOM FOR A STAGE.

"YOU will reach Caister to-morrow morning, and I hope, as it is for the honour of your country, you will not object to hard work, and if necessary, overwork. We rely on your invention to give us a chance of self-defence, and as you may well guess, should it prove of any success to us you will be more than adequately indemnified for your trouble, and I have no reason to doubt but that you will win the thanks and gratitude of your country. As soon as anything is known with regard to the diplomatic situation you shall be informed. At present I have told you all there is to tell you. Now, good-night, Mr. Summers; I think I will take charge of these papers until to-morrow, so I have made arrangements for you to call here before you go to Caister."

Charles thanked him, and placing himself once more in the hands of his attendants, he re-entered the motor-car and was whizzed to a private hotel in Victoria, where a comfortable suite of rooms was awaiting him. He much wanted to write to his people in order to relieve any fears they might have on his account, but he was told that such a course could not be permitted until he received the sanction of the War Office. Therefore he had to be content with smoking his soul out in cigarettes and with the company of his far from rosy thoughts.

Nevertheless his was the better part as compared with that of the monotonous waiting for news his people were forced to endure; for he was called to action, and after the few hours at the hotel had dragged by, he had little time to think of anything but his work.

The following day, as had been arranged, he saw Sir Henry, and received back his bundle of papers. At the same time he asked about correspondence, and he was allowed to write a vague letter containing a certain amount of reassurance to his father, but he was told that in future all correspondence would have to be censored, and he was on no account to inform his people or anybody of his whereabouts, while any letters that they should send to him were to be forwarded to the War Office, and thence they would be despatched to him.

Caister is a name rather than a town. It is a miserable collection of straggling cottages, primeval in their construction, and forlorn in appearance. The few fisher people that live here have only one thing to be proud of, the wireless station in the vicinity; and the recent addition of rows of uncomfortable dwellings built for the workmen at the station have not improved the appearance of the place; rather they have made it a sorrier spectacle than ever it was before, for they have introduced an element of forlorn humanity, and thereby accentuated the abomination of desolation. Charles was accommodated in a little bungalow which had been erected especially for his convenience. It was clean but comfortless, and that was the best that could be said for it. Perhaps it was just as well, as it gave him no inclination to take things easily, and he was soon engrossed in his labours. Clever engineers and an able staff of workmen were at his disposal, and it was not long before the skeleton of a powerful airship was constructed in the hangar. Some difficulty was experienced in getting material that was light enough yet strong enough to bear the strain of the work it had to do, and the silk envelope was also a perplexity. These hindrances were, however, ultimately overcome, and in less than

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three weeks after commencing operations the enthusiastic band of workmen were exultant in the accomplishment of the framework of the machine. But they were not given long in the contemplation of their success; word came while yet the last bolts and switches were being adjusted that war had been declared, and any day the invasion of England might be commenced. Immediate fear was allayed somewhat by private information that the Germans were almost as unprepared for action as England. Mishap after mishap had interfered with their progress, and it was rumoured the Army had abandoned the idea of making an invasion by airship, and were going to rely solely upon their fleet of planes. This was extensive but not sufficiently powerful enough to make an invasion effectual. Therefore they were building as fast as they could, but it would be some weeks before anything like a serviceable number would be in readiness. Thereupon Charles and his men redoubled their energies. Apparatus was designed, constructed and ɒɯsed with incredible swiftness, yet not so fast as to interfere with perfect accuracy and workmanship. At last one night it was decided that a trial spin should take place, and the excitement in the little bungalow was intense. At 12 o'clock Charles took his place in the transmitting room of the station, where a temporary tower had been erected and a switch-board installed therein. Here, besides, was a long distance "sighter" of immense power, which was in itself a triumph of workmanship, representing the combined efforts of the best lens makers in the land to complete.

It had an immense telescopic range, and it worked in conjunction with a searchlight, which threw out a brilliant ray for miles, and would enable the operator to see clearly the manœuvres of the airship. Moreover, a special arrangement had been constructed so that it could be manipulated in conjunction with and at the same time as, the switchboard, so that it could keep in touch with the evolutions of the airship, and follow it about, keeping always its steady beam of light on the vessel, so that there was no danger of the operator losing sight of his machine in the prevailing darkness. Magnificent in the extreme was the sight of this vessel as it slowly emerged from the hangar, and climbed up the ladder of light penetrating into the night. As soon as Charles considered the elevation sufficient he manipulated the keys, and both searchlight and vessel swung round in combined motion, making great sweeps and curves, then plunged swiftly forward out over the sea until the machine looked little more than a mote in a sunbeam, glittering with light and twinkling brilliantly as it became more and more enveloped in the atmosphere. It was a spectacle that would have moved even the uninitiated, but to those who had had a hand in producing it and bringing it to this perfection it was a miracle. The excitement of the onlookers was intense, and reached a climax when Charles, after he was satisfied with the manœuvres, turned it round and steadied it towards the hangar, which it circumscribed, and then as easily as a bird with folded wings glided into the nest prepared for it. There was a roar of applause so exultant that even sleepy Caister outside the sacred precincts of the wireless station was half roused from oblivion by the confused echo of the tumult.

CHAPTER XII.

MUTUAL RELATIONSHIPS.

But to hark back to Sotheby. Things there were very dull indeed. Of course Charles's absence was soon noticed, but it was successfully explained away, and so supplied no source for the eternal stream of village gossip. Nevertheless for the Vicarage people it was a period of suspense which was hardly bearable, and only the ordinary day's work which had to be done afforded anything like a palliative to their strained nerves. With Gwen, however, it was different. She had so little to occupy herself with that she was forced to dwell on the incidents of the last few months, and something very like remorse made them loom appallingly large in the retrospect. They became ugly phantoms, grotesque and fantastic shapes, which lurked in the crevices of her brain, or spread their gloomy forebodings over her imagination. Realising that something had to be done to dispel them or that otherwise she would give way under the strain, she applied herself feverishly to outdoor sports and to the affairs of the house. More often than

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formerly she made journeys to town, and in fact did everything to take her out of herself. To a degree she was successful, but in the moments when she allowed herself to think the conviction grew upon her that Charles's present predicament was due in a large measure to her own want of thought and inconsiderate talking. But that was not her greatest trouble. She dared not think of her attitude to him on that momentous afternoon of the arrest. What a miserable little egotist she had been, and what suffering she must have caused him! She would have given anything now to cancel that last scene, but it was too late now. It was horrible to think of Charles with only that to look back upon. How she longed to be able to make atonement of some sort for her blind selfishness, but the wish she knew was futile; all she had to do was to grin and bear whatever fate had in store for her.

One consolation, however, she found, and she accepted it in her usual impetuous way. It was one little likely to have reassured Charles had he known of it; but perhaps it was as well he did not, for in his ignorance it did not affect him, and it at least afforded some relief to Gwen—that is to say, Gwen found more and more relief in the companionship of Braithwaite. It was like her to be perfectly unaware of the state of her own feelings, and had the bare idea of such a thing been imputed to her, she would have indignantly denied the reproach.

For the first few weeks after the departure of Charles, the young aide-de-camp had kept aloof as much as possible. Life, young though he was, had already taught him many lessons of the world, and in his intercourse with various women he had mastered all "the rules of the game." He was an apt learner, a keen observer, and he knew to a nicety the right thing to do at the right moment. Therefore he forebore to inflict his, as he guessed it would be, odious presence on the girl, knowing full well that when the first effects of the blow had subsided she would be glad of the society of a man of her own age, who besides had many interests in common with her own, and who knew the ins and outs of the present case. But it must not be imagined that Braithwaite was scheming and underhanded, or endeavouring to supplant Charles. He had no intention of doing such a thing, only he was attracted to the girl; chance had thrown him into her company, and he saw no reason why he should forego the pleasure of her society. He wanted it to be a mutual pleasure, therefore he took the proper means for that end, and ultimately he was successful in re-establishing the old footing of comradeship which had been so dramatically upset. At least, he was successful to a certain degree, but he was not slow to perceive that although to all appearances they were on the same terms of intimacy, there was a "something" which divided them. Gwen was not so spontaneous. She never let herself go as she had done before. Often when it seemed they were particularly friendly, she would suddenly rein herself in and resume the defensive attitude. Such action Braithwaite interpreted to himself as self-consciousness, and to some extent he was right, but the egotist which is in every man blinded him to the fact that this self-consciousness sprang from a finer motive. For Gwen was learning how much her old lover was to her; she missed him terribly. Braithwaite served very well as a substitute, as a means whereby she might disburden herself of some of her present anxieties, but he was to be no more, and it was only when the impetuous girl in her was uppermost that she allowed herself the luxury of his sympathy. Often at such times she would suddenly recollect that she was a woman, with her own responsibilities both to herself and her lover, and then Braithwaite would be thrust again into the background to make what he might of her moodiness.

In this way, she imagined—whenever she gave her actions a moment's thought—that she was playing her proper part as *fiancée* of the man whose ring she wore on her finger. But here it was her ingenuousness which thus deceived her, for had she been more worldly-wise she would have known that no conduct on her part was more likely to urge on the man she did not love. Truth to tell, she was very innocently, and albeit very successfully, playing the part of the coquette, and was fanning the flame of Braithwaite's mild affection into ardour by her frequent gusts of friendliness and disdain. Such was the actual state of affairs; but to themselves, because they were not metaphysicians, it merely seemed that they met and

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parted like ordinary folk, discussed things in the ordinary way, and generally made the best of present circumstances.

Meanwhile Charles, at Caister, had discarded all personality, and only the scientist in him remained alive. Sterling lover though he was, his personal affairs always came second to his work. Whenever the call of science reached him it became the dominant influence, and there was no room for anything else. All other interests had to be put aside till the call had been answered. It never occurred to him that he was a man before he was a machine, and that as a human entity he had duties and responsibilities which were of equal importance with his scientific work, and that, looked at in its true light, complete absorption in his inventions was somewhat selfish, and not quite fair to his partner. Even if the case had been clearly laid before him, and it had been pointed out that he himself would in a large measure be responsible for any alienation that might occur in Gwen's affections, he would have been utterly at a loss to understand. At heart the most generous of lovers, he deceived himself that all the work he was doing was done for the sake of the woman. So now, as the weeks elapsed, he became more and more absorbed in his schemes to evolve a complete system of aerial defence for Caister. His other life was fast becoming a dream which had slipped away; when it was all over he would come back to his own self. But it was not all over yet. For one thing he had a tremendous scheme in hand for perfecting the guidance of his airship. In his experiments on wireless, and his readings on the subject, he had picked up many fantastic ideas, which at the time seemed to him clever impossibilities, but now that he was gaining proficiency in his new science the more he thought of them the more convinced he became that they were possible, and this conviction had at last resulted in an impulse for invention. Necessity, as the proverb saith, was the mother thereof. When he was conducting experiments with the airship at night, and using the flashlight, he was forced to realise that this method of locating the whereabouts of the vessel was clumsy and dangerous. If he could see it in the blinding rays so could the enemy, and that was not what he wanted. He must find some means which would enable him to locate his vessel without giving his opponents a chance of discovering its whereabouts.

A week of cogitation and the scheme was outlined. A few days later it was planned, and the design almost completed. Then came the worst part of the business; the translation of the ideal into the real. It was one thing to sketch the plan on paper: it was quite another to make it practical, but after many attempts and failures he managed, with the intelligent co-operation of his workmen, to evolve his machine. First of all a species of camera obscura was fixed over the wireless table. In appearance and position it was much like the looking-glass poised over the head of an organist, but at the back was a mechanism which practically defied description. It resembled nothing so much as an intricate spider's web of fine wires passing hither and thither, in a combination of spirals, diagonals and squares. For its manipulation the room had to be in almost perfect darkness, only one adjustable light being installed, so as to throw its rays on the keyboard of the operating table. At the will of the operator it could be turned on the switch-board. Then a delicate machine was fixed in the exact centre of the airship. It was after the nature of a concentrated transmitter, and it worked in connection with a high power coil, and could transmit automatically wireless waves. These were tuned up to a particularly high note, and were treated directionally at right angles to the airship itself. They communicated with a special receiver fixed by Summers behind the glass screen. There the note acted on an electric spark, and thus indicated the position of the airship, for in the darkness the light shone like a glowworm behind the screen and travelled along the fine wires placed there for the purpose. Charles's greatest difficulty was, however, to find a means of indicating the distance the airship might be from the Marconi tower where he was working, and this he could only overcome in a somewhat clumsy fashion, for the time at his disposal did not allow him sufficient latitude to indulge in specious experiments. Therefore he did the best he could with a sighter similar to that used on 16 in. guns, and then when he required to ascertain the distance would send out a flash

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from the airship, and so could locate it with sufficient accuracy for his purpose. He, nevertheless, found it very difficult to manipulate the additional apparatus in conjunction with the work of directing the airship. Night after night he sat up carrying on experiments and gaining proficiency. It was fascinating work to direct this machine across the wilderness of stars or scudding clouds, and to see nothing as he gazed out into the darkness from the sighter, then to touch the key which would produce the emission of a flash, and to discover the airship a mere golden dot in the lens. Then, again, darkness would prevail, with only the little glow of light in the mirror above his head creeping round and round, now darting straight, now curving to the touch of his fingers on the keys. It was worth living to have accomplished so much, and it was no wonder that in the exuberance of his triumphs he forgot that he was a lover, and a broken-hearted one at that, for he knew that he was on the threshold of achievement, and that this was his own child, the child of his invention. It was his own genius that had created this wonderful star that shone out or hid itself according to his will, silently and powerfully journeying across space, and steering its course between the stars. He had good reason to be proud of his skill.

CHAPTER XIII.

WAR!

News! News! The world was full of it. The newsboys were tearing through the streets of London, snatching ha'pence and delivering newspapers to the passers-by. It was as though the heavens had scattered news-sheets broadcast from the skies. Everybody was buying a paper and scanning its contents. Endless excitement prevailed. It was to be seen in the anxious faces among the little groups of pedestrians discussing the question of the hour. War had been declared. The two greatest nations in the world would soon be at death grips, and the fact was sufficient warranty for the prevailing excitement. Even the news reached Summers, a prisoner in the Marconi tower at Caister; but it was not brought with the melodramatic touch of great printed placards and the hubbub of conversation. Instead, he received it from the officer in command of the station, who had on his part been supplied official information from the War Office. England had been the first to strike the decisive blow, and herein Charles could claim to have done his part in enabling his country to take the offensive; for throughout the period of his work at Caister his progress had been reported to the War Office, while Sir Harry Dever, with other officials of yet more consequence in military matters, had watched several of the trial trips he had made with his airship, and they had convinced themselves that his invention was important enough to give their aerial armament the prestige that was necessary before the government could take this important step. Now everything was in readiness for action: their home squadrons were brought up to full fighting strength, and would effectually prevent the German navy from gaining much advantage in an attempted invasion of England. Their defensive air fleets were concentrated on the south and south-east coasts, and would be sufficient to prevent any effective landing of the German invaders in those parts. The Imperial fleet was also concentrated, and its object was to blockade Heligoland and the other German ports in the Baltic. If need be, it was deemed of sufficient strength to land forces on the German shore which could assemble under cover of the powerful guns until an adequate force had been organised to make an advance on Berlin practicable. This the Germans knew, for England had been at no pains to keep them ignorant. They had given her spies every advantage, and these paltry servants of the Fatherland had made what they deemed to be good use of their opportunities, so that their government had received corroborative reports from several quarters. For these reasons the English defenders felt themselves fairly secure, and on the strength of the added security of Summers' defence they had allowed the Caister position purposely to seem a weak spot in their coast armour. And here the advice of Sir Harry Dever regarding the procedure to be adopted in respect of Charles and his airship was vindicated. Not a whisper of his doings in this out-of-the-way spot had as far as they knew reached foreign ears. As a matter of fact, they were themselves in the dark as to whether anything had been done with the plans their emissaries

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Dupont and Beulner had secured, but they were practically convinced nothing could have been accomplished in the time which had elapsed since the theft and the declaration of war; for easy as it may be to build a vessel with the designer at hand to guide and advise, it is infinitely difficult to make out the mechanism from a specification which can neither elaborate or explain its provisions. But cleverly as everything had been thought out and every mischance guarded against, the human mind, and even a collection of minds, is not equal to all emergencies, and an incident was shortly to take place which was to occasion no little alarm. The Germans perceived that by declaring war England had cut the ground of invasion from under their feet. They further foresaw that though they might repel any invasion of England, it would be little to their advantage; for, if it came to a question of a struggle, it was the wealthiest nation which would hang out longest, and in such a contest England would eventually gain the day. They, therefore, decided on a bold plan of action, relying chiefly on the slackness of the first phase of the war to make good their purpose. A fleet of several light cruisers and torpedo boats was sent out from Hamburg to engage the attention of the British warships. The oldest vessels in this class were commissioned for the purpose, and in a dense fog they appeared one night, not far to windward of the enemy. An engagement took place with the foreseen results. Nearly all of the rash German vessels were sunk, and the others put back to port greatly crippled. But in the darkness and general confusion two small continental steamers had slipped by unnoticed, and now stood far out in the North Sea. They were quickly followed by submarines, who quietly took up a position alongside and unloaded what appeared to be a considerable cargo. They then formed a cordon of defence round the continental steamers, while some German battleships, coming up from American waters, received instructions to do the same. Shortly after the unloading a great hammering and noise of building took place on the steamers, and soon it was apparent that a vast stage was being erected right across the upper decks of the vessels, and far out over the bows. When this was accomplished its purpose was soon evident. It formed a stage to allow for the erection of aeroplanes. These were the packages which had been brought on board by the submarines, and cunning workmen were taking part in their construction, for they were completed with amazing swiftness. This final part of the scheme was commenced one night immediately after sunset, and continued practically till dawn. By that time forty planes had been let loose and formed a compact aerial fleet, ready to make a swift descent on England. Each carried three men, and it was reckoned that a force of one hundred and twenty men fully equipped with machine guns reaching a secluded part of England would be able to hold out for sufficient length of time to allow other planes to be dispatched with reinforcements. These were to come direct from the German coast, and would be despatched as soon as news had been received of the departure of the vanguard from the North Sea floating-station. Meanwhile, at that station further supplies of collapsible aeroplanes were to be forwarded by submarine, so that there should be no hindrance in the augmentation of the invading fleet. The obvious destination was the Norfolk coast, and one morning, while yet the light was still blurred and indistinct, they set sail. Caister was unaware of the turn of events until the station received a call from the fleeter of a North Sea fishing squadron. The message was brief, but of sufficient importance to cause a break in the usual quiet routine of the day. It stated that the fleeter in question was cruising off the Dogger Bank when the look-out man had observed some aeroplanes—the exact number was not ascertained—rising far out to the sou'-west by west, believed coming from Germany and heading to England.

Immediately the conclusion was drawn that an invasion by air was imminent, and Charles was warned of the danger. Fortunately everything was in working order, and it was only a few moments before Charles was ready and waiting at his post in the Marconi tower.

But it is one thing to work at your ease and quite another to be fighting, not physically, but mentally, for not only honour but for the safety of one's countrymen, and the strain was so great that beads of perspiration stood out on the operator's brow.

(To be continued.)

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INSTRUCTION IN WIRELESS TELEGRAPHY

The Tuning Buzzer and Magnetic Detector.

(Tenth Article.)

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. The article in the March issue will complete the series and special attention is therefore directed to the notice which appears on p. 708 of this issue. Back numbers of THE WIRELESS WORLD in which the earlier articles have appeared will be sent by the Publisher at Marconi House, Strand, London, W.C., on receipt of remittance of 5d. per copy to cover cost of postage.]

66. In the January article we described a form of tuning buzzer which required two batteries, one for working the vibrator and the other for exciting the oscillatory circuit. This form of buzzer required two vibrating contacts mechanically connected together but electrically independent, operating the two different circuits.

There is no reason, however, why the ordinary single contact buzzer cannot be used for exciting an oscillatory circuit, for by connecting it in such a way that the current passing through the coils of the buzzer is made to pass also through the induction coils of the oscillatory circuit, as shown in Fig. 1, we have practically the same

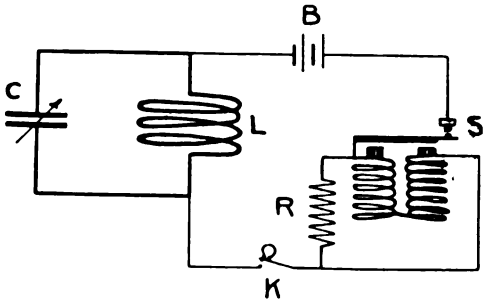

Fig. 1.

conditions as before, because energy will be stored up in the inductance, L, while the current is passing through it, and will be liberated as soon as it is interrupted at the contacts, S, the energy thus liberated giving the oscillatory circuit a kick, and thus causing it to oscillate with its own natural frequency In this case, however, when the contacts, S, are broken, we not only liberate the energy stored up in the inductance, L, but we also liberate the energy which is stored up in the inductive coils of the buzzer itself.

The inductance of these coils is many times greater than the inductance in the oscillatory circuit, and therefore a very much larger amount of energy will be liberated at this point when the circuit is interrupted. If no path is provided in which this energy can dissipate itself, it will form a small arc at the contacts, S, and dissipate itself gradually in this manner.

Unfortunately this arc will also form a path for the energy stored up in the inductance, L, with the result that the energy will be dissipated in the same way without passing through the condenser, so that under these conditions the oscillatory circuit would not be efficiently excited.

If, however, we connect a non-inductive resistance, as shown by R, Fig. 1, across the coils of the buzzer, the liberated energy from the buzzer coils will be absorbed in this resistance, instead of forming an arc at the contacts, S.

The connections shown in the figure are those usually adopted in an ordinary tuning buzzer, and it is obvious that the instrument can be used either to buzz a calibrated closed oscillatory circuit, and so make it emit waves of any desired length for the purpose of testing receivers, etc., or it can be used to buzz any oscillatory circuit in order that the wave-length of that circuit may be measured by means of a wavemeter.

We have now explained briefly the principles which are made use of in the design and application of crystal receivers. There are, however, many other forms of receiver, some of which make use of phenomena entirely different to those already explained; but space will only allow of our describing one

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such receiver, which has certain practical advantages over the various forms of crystal receivers—namely, the magnetic detector, in which use is made of that property in iron known as magnetic hysteresis.

67. Magnetic Hysteresis.—If a piece of iron be brought near the pole of a magnet, that part which is nearest becomes magnetised to an opposite polarity by magnetic induction.

If it is then removed from this magnetising force, it will still retain a certain amount of the magnetism induced into it, by reason of its " hysteresis " or " retentivity."

In the case of soft iron, this residual magnetism is extremely unstable, and a very small mechanical shock or twist is quite sufficient to destroy it.

In paragraphs 3 and 4 of the May number of THE WIRELESS WORLD, under the heading of " Magnetic Induction," we explained how an electric current could be induced in a coil of wire either by the introduction of a magnet in the coil or by removing a magnet from the coil.

If, then, we wind a coil of wire round a soft iron core and, after magnetising it, we subject it to a mechanical shock, sufficient to destroy its residual magnetism, a current will be induced in the coil of wire. Moreover if we connect a pair of telephones across the coil, thus causing the current induced into it to pass through the telephones, we shall get a click in the telephones when the iron is de-magnetised.

Having de-magnetised the iron, it must be re-magnetised before a similar mechanical shock will produce another current impulse in the coil.

It is obvious that the intensity of the current induced in the coil of wire will depend on the difference between the amount of magnetism in the iron before and after it is subjected to the de-magnetising influence of the mechanical shock.

A very feeble shock will only partially de-magnetise the iron, with the result that a feeble sound is produced in the telephones; but if the shock be sufficiently strong to destroy all the magnetism in the iron, we shall get a maximum sound in the telephones, and any further increase in the strength of the shock cannot further increase the sound produced in the telephones.

We have, however, a means of still further increasing the strength of the current induced in the coil. Owing to its hysteresis the iron will retain its residual magnetism, not only when the magnetising force has been removed, but also when it has been reversed, provided that this reversed magnetising force is not too powerful.

In this case the effect of our subjecting the iron to a mechanical shock is not merely to destroy its residual magnetism, but to allow it to become magnetised in the opposite direction by the influence of the reversed magnetising force.

The intensity of the current induced in the coil will then be proportional to the amount of residual magnetism in the iron which is destroyed *plus* the amount by which it is magnetised in the opposite direction.

It was discovered that if a high frequency oscillatory current were passed through a coil of wire wound round a piece of iron, that it produced an effect on the iron similar to that produced by a mechanical shock.

68. Let us now see how these principles were applied by Mr. Marconi to the magnetic detector.

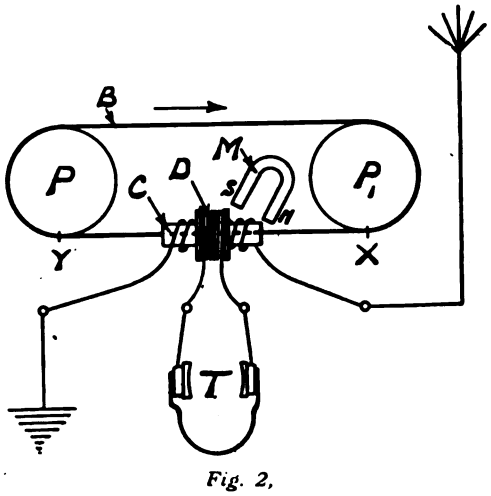

Fig. 2.

An endless band, B, Fig. 2, consisting of a number of fine strands of iron wire, is passed over two pulleys, P P, one of which is kept slowly rotating by means of clockwork, thus keeping the band continuously moving in the direction indicated by the arrow. The band is made to pass through a small glass tube, C, around which is wound a single layer of insulated copper wire, the

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two ends of which are connected, one to the aerial and the other to the earth.

A second coil of wire, D, consisting of a very much larger number of turns of wire, is also wound around the glass tube, and across this coil is connected a pair of telephones, T. A single horse-shoe magnet, M, is placed in a position similar to that shown in Fig. 2, with one of its poles (in this case the north pole) close to the band a short distance away from the windings, the other pole a little distance away from the band near the middle of the windings.

Let us now watch the progress of any particular portion of the band while it travels from the point, X, to the point, Y.

It first of all approaches the north pole of the magnet and thereby becomes magnetised as a south pole by magnetic induction. As it proceeds further on its course, it gets further and further away from the magnetising influence of the north pole of the permanent magnet, but, owing to its hysteresis, it will retain a certain amount of magnetism. As it enters the glass tube it commences to come under the weaker influence of the south pole of the magnet, which is tending to make it into a north pole, but unless disturbed it will retain its original residual magnetism.

If, however, an oscillatory current is received by the aerial, this current will pass round the single layer winding on the glass tube and allow the magnetism in the iron to be reversed, thus causing a sudden change in the magnetic field, and thereby inducing a momentary current in the secondary coil, to which the telephones are connected.

If, on the other hand, no oscillations are received in the aerial, the iron will pass through the primary tube without having its magnetic polarity suddenly changed, and therefore no sound will be produced in the telephones.

It will be seen, then, that we have a continuous supply of iron inside the primary tube in such a condition that oscillatory currents passing through the coil of wire will cause it to change its polarity suddenly.

As each spark of the transmitter produces a train of waves, so does each train of waves received by the magnetic detector produce a click in the telephones. Thus the click in the telephones will produce a sound similar in frequency to that produced by the transmitter.

Experience has shown that this detector is quite the most reliable and robust which has yet been invented, but although extremely sensitive it has not got the sensitiveness of the modern crystal detectors. Its reliability, however, makes it a valuable instrument as a stand-by, or in places where experienced operators are not obtainable.

To tune up the magnetic detector to any desired wave-length, an adjustable inductance and an adjustable condenser are joined in series with the de-magnetising or primary winding of the detector.

No tuning is required for the secondary or telephone winding, so that normally the magnetic detector can be regarded as a single circuit receiver.

As this arrangement does not give particularly sharp tuning, an instrument was designed, known as the multiple tuner, through which the oscillations have to pass before reaching the primary winding of the magnetic detector.

The multiple tuner consists of three closed oscillating circuits acting inductively upon each other, each of which is adjustable for wave-length. And a diagram of connections of a simple form of this tuner is shown in Fig. 3.

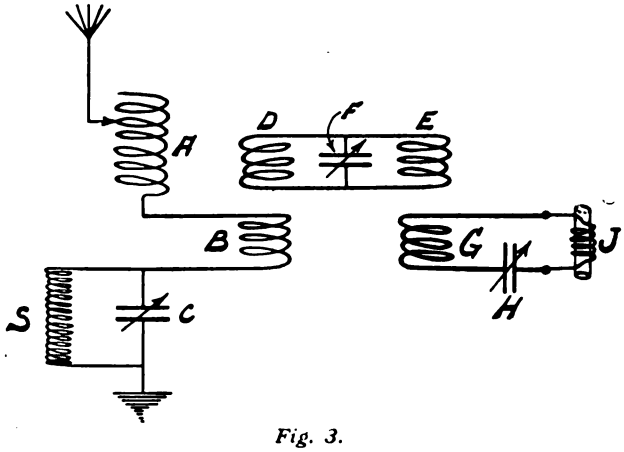

Fig. 3.

As will be seen from the diagram, there are three distinct circuits, namely, the aerial circuit, the intermediate circuit, and the magnetic detector circuit.

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Each of these circuits must be in tune with the wave-length it is desired to receive.

The aerial circuit consists of an adjustable inductance, A, an inductive winding, B, and an adjustable condenser, C, all connected in series with one another.

The tuning of the circuit is accomplished by the adjustable inductance and adjustable condenser.

The inductive winding is so placed that any oscillations in it induce similar oscillations in the intermediate circuit, which consists of two inductive windings, D and E, connected in parallel and across an adjustable condenser, F.

Any oscillations induced in the winding, D, will also flow in the winding, E, since the two windings are in parallel, and the wave-length of the circuit is adjusted by changing the capacity of the condenser, F.

The third circuit—the magnetic detector circuit—consists of an inductive winding, G, and an adjustable condenser, H, and by itself is incomplete, but it is completed by connecting across it the primary winding of the magnetic detector as shown by J.

The telephones are connected as described before, across the secondary coil of the magnetic detector.

"ATMOSPHERICS."

Electric disturbances in the atmosphere which affect the receiving apparatus of wireless telegraph stations are known by the name of "atmospherics."

They produce in the telephones noises which, if strong enough, can drown the message which is being received.

Where small aerials are being used these atmospherics are not usually at all troublesome, but where large and high aerials are employed, if measures are not taken to reduce their effect, it would be impossible, sometimes for days together, to communicate at all.

The difficulty in getting rid of "atmospherics" is that they have no particular tune, but will cause the aerial circuit to oscillate to its own natural frequency, so that, no matter to what wave-length the circuit is adjusted, "atmospherics" are still induced in the receiver.

At first sight, therefore, it seems an impossible problem to get rid of them. It has, however, been accomplished as follows: Two receiving circuits are opposed to one another in such a way that if equal effects are produced in each circuit, these effects are neutralised, and therefore produce no sound in the telephones.

If one of these circuits is in tune with the wave-length being received, and the other circuit is out of tune with this wave-length, unequal effects will be produced in the two circuits by the waves, and the signals will be received in the ordinary way.

The "atmospherics," however, as already stated, will affect both circuits equally, so that the effect of the "atmospherics" is neutralised, and they will produce no sound in the telephones.

There is another form of "atmospheric" which is extremely troublesome, should a condenser be connected in series with the aerial for the purpose of tuning.

These atmospherics charge up this condenser in such a way that the charge grows until either the condenser is broken down or until the charge sparks across the two sides of the condenser.

This kind of "atmospheric," however, can very easily be dealt with by connecting a coil of wire, as shown by, S, Fig. 3, from the aerial side of the condenser to earth, which allows the current to pass through the coil of wire to earth instead of charging up the condenser.

It is, however, necessary that this shunt be highly inductive, as otherwise not only would the current caused by the "atmospherics" pass through it, but also the oscillatory currents which it is desired to receive.

For this reason, in nearly all receivers that are provided with an aerial tuning condenser, a coil of wire, known as an inductive shunt, is connected from the "aerial" side of the condenser to earth.

An Announcement.

The course of Instruction in Wireless Telegraphy, which commenced in the May, 1913, number of THE WIRELESS WORLD, will be completed with the final section, which will appear in the next number, in which number there will also be published an announcement concerning the holding of the examinations and the awards to be given to successful candidates.

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Administrative Notes

U.S.A. Coast Station.

THE short-distance station at South Wellfleet, Massachusetts, U.S.A., has been discontinued, the service ending on December 31st, 1913. All messages are now sent *via* the station at Boston (call letters WBF).

* * *

Gambia Telegraph Ordinance.

An Ordinance entitled "The Telegraphs Ordinance, 1913," provides for the regulation of telegraphs in the Gambia. Under the Ordinance no person may establish a telegraph station or instal or work any apparatus for wireless telegraphy in the colony except under a licence granted by the Government. Merchant ships in the territorial waters of the colony must not use wireless telegraphy in such a way as to interfere with naval signalling, or with the working of wireless stations established in the colony. Merchant ships must not work wireless telegraphy (except for the purpose of making or answering signals of distress) whilst in any harbour or bay of the colony, except with the special permission of the Governor.

* * *

New Zealand Ship Rates.

The rates for wireless messages between the New Zealand coast stations and most of the ships off the New Zealand coast have been reduced from 10d. to 5d. per word. A statement to this effect was made recently in the House of Representatives by the Hon. R. H. Rhodes (Postmaster-General). The Leader of the Opposition had urged the Postmaster-General to use his influence to have the wireless rates reduced, and Mr. Rhodes said that he had already been in communication with the Board of the Amalgamated Australasian Wireless Company. The latter, he added, had intimated that they were agreeable to comply with his suggestions for reducing the present radiotelegraph rates on board ships operated by the company trading exclusively between Australia and New Zealand, and between ports on the coast of New Zealand; the total charge to be 5d. per word, and divided in the proportion of three-fifths to the coast station and two-fifths to the ship station. In the course of the letter to him, the company said:

"For the exchange of telegrams exclusively between ships to which the reduced rates will apply, we foresee some difficulty in making a similar reduction, because the arrangement at present applies only when they are in communication with the New Zealand coast stations, and not during other parts of their voyage. We think the best arrangement for the time being will be to make a rate of 4d. per word for messages exchanged between any two ships licensed by your administration—*i.e.*, 2d. per word for each ship, and when communicating with ships licensed elsewhere, the present ship tax of 4d. per word should be charged for such other ships, and 2d. per word for the New Zealand ship.

"We propose, if, after a suitable trial, the reduction is justified by a sufficient increase in traffic, to approach the Commonwealth Government with a suggestion to apply similar rates on the Australian coast; and if this is done the reduced ship tax can be applied to all communications between any ships registered in the Dominion or the Commonwealth."

The company suggested that the new rates should come into force on January 1st last.

There is a new word in the English Dictionary—to Marconi—past participle Marconi-ed.

* * *

RESEARCH IN WIRELESS TELEGRAPHY.—With the consent of the Army Council, the Postmaster-General has appointed Lieutenant-Colonel Fowler, Commandant of the Army Signalling School, to be a member of the Committee on Research in Wireless Telegraphy, of which Mr. Hobhouse is chairman.

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Practical Hints for Amateurs

A Universal Detector Stand

By A. W. HULBERT

ALTHOUGH a multiple crystal-detector is very useful for quickly selecting various crystals, a universal stand acts just as well, and is not so complicated. The usual type of stand is that with two holders or cups fitted with clamping screws. The disadvantage with this type is that there is only one sound electrical connection between cup and crystal, *i.e.*, where the clamping screw presses tightly against it. This defect is remedied by using spring forceps with a number of teeth, A, Fig. 1, on each side, thus making electrical connection in several places on the crystal.

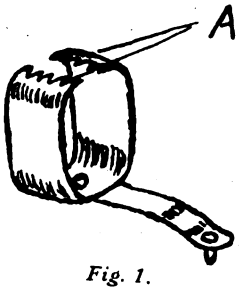

Fig. 1.

A universal stand of this type is constructed as follows, Fig. 2 :—

The base, D, should be of teak wood, stained and polished; a useful size being 9 in. by 6 in. The main pillar, A, is a piece of brass tubing $\frac{3}{8}$ in. external diameter cut into three lengths; 1 in., $\frac{3}{4}$ in. and $1\frac{1}{4}$ in. respectively.

On each side of the $\frac{3}{4}$ in. length is a thin strip of brass 3 in. long and $\frac{1}{2}$ in. wide, B B. A similar strip, E, 3 in. long, $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. thick, is placed on top of the 1-in. length of tubing, A.

The complete main pillar, A, fitted with the two strips of brass, B B, and strip, E, is now fixed to the base by means of a brass bolt which runs right through the main pillar; holes being drilled through the brass strips, B B and E, to allow this to be done. The bolt should go right through the base, a nut securing it underneath. A thread should be cut in the strip, E, to take the pressure screw, F. The strip, G, should be of springy brass and bent to the shape shown, G.

It is fastened to B by a bolt which passes through a piece of brass tubing $\frac{3}{4}$ in. long, X, and clamps, B B, X, and G, together.

The construction of the forceps, AA, can be clearly seen by referring to Fig. 1. They should be cut from springy brass, a good size being $\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. high overall. The upper forcep should be fastened to the brass strip, G, Fig. 2, a small nut and bolt being used for this purpose.

The lower forcep should be attached to a brass strip 2 in. long and $\frac{1}{2}$ in. wide, which is screwed to the base. A wire runs from here to the terminal, H. The other terminal (not shown) is connected by a wire to the main pillar by means of the brass bolt before mentioned. Some good crystal combinations are, Bornite-zincite, galena-graphite, silicon-zinc, copper or gold point. The gold, copper

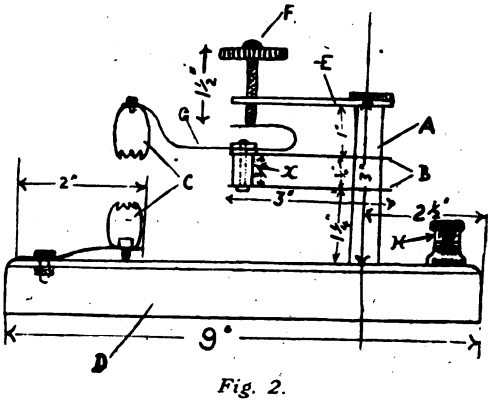

Fig. 2.

and zinc points should be soldered on to small bolts, so that when they are to be used it is only necessary to unscrew the upper forcep and to put the particular pointed wire in its place.

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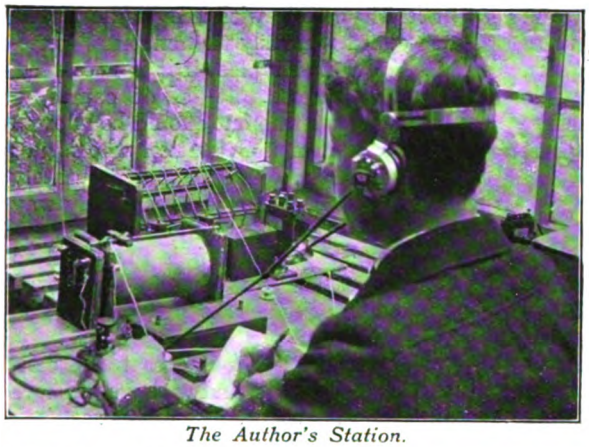
AN AMATEUR'S WIRELESS STATION.

By G. F. STEVEN.

IT is some eight months ago since I first took up the study of wireless telegraphy; and I have had more than the ordinary share of success. I owe my keen interest in wireless to *The Marconigraph*, and to THE



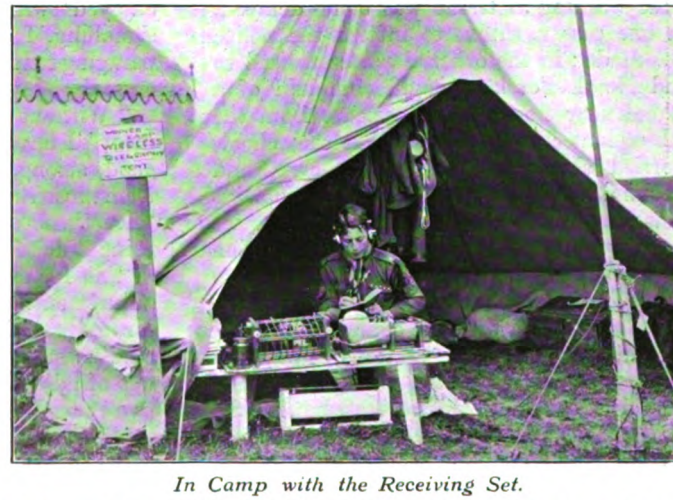
The Author's Station.

WIRELESS WORLD, from which I obtain invaluable help.

The aerials of my station are of the ordinary flat ship type and consist of two wires 180 ft. long, No. 18 gauge single-strand copper wire, at an average height of 30 ft. This gives me a wave length of about 184 metres. The leads are taken into the workshop where my apparatus is connected through glass tubes, which form perfect insulators. There is a tin plate 3 ft. by 2 ft. buried to a depth of 3 ft. 6 in. for earthing purpose.

I use a crystal detector, which consists of silicon and a gold point. As to tuning instruments, I first made a single slide tuning inductance, which tuned up to about 2,000 metres. This coil was 9 in. long by 4 in. in diameter, and was wound with No. 22 d.c.c. on a postal tube. But I could not cut out signals properly when they were not wanted and I made an oscillation transformer. The primary of this instrument is 4½ in. in diameter and 8 in. long, and is wound with No. 26 enamelled copper wire on a postal tube well coated with shellac varnish. The secondary is 7 in. long and 4 in. in diameter, and is wound with No. 28 enamelled copper wire. A slider on a brass rod is fitted for the variation of the primary, taking in one turn at a time. The secondary, however, is divided into 10 parts, thus ensuring very good tuning. This oscillation transformer will tune in stations up to about 4,000 metres wave length. For stations with greater wave lengths an extra tuning induction is used. The extra induction is 14 in. long and 4½ in. in diameter, is wound with No. 22 enamelled copper wire, and is divided into four parts which in series tune in 6,000 metres. My telephone condenser is made of paraffin waxed paper and tinfoil in an old cigar box fitted with terminals, the capacity of which is ·004 m.f. My telephones are of a well-known make, and are of a total resistance of 2,000 ohms.

My sending apparatus consists of a ¾-in. spark coil, which takes 8 volts 2 amperes. The spark gap, which consisted of two brass balls, has since been changed for one of zinc. The tuning of this set is effected by a helix wound with No. 10 copper wire on an 8 in.



In Camp with the Receiving Set.

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frame. The condenser is of the Leyden jar type, and consists of a ¾-pint jar and tinfoil.

I have constructed a portable receiving set, which consists of an oscillation transformer, galena detector, condenser, and telephones, and I took it to the boy scouts' camp last summer. The camp was held among the Cheviot Hills, 500 ft. high above sea level. After erecting two scaffolding poles, I put up the aerials, which were 30 ft. high and 200 ft. long. With my set, using these aerials, I received a great number of signals, both from shore stations and ships, while the time in camp was taken from the Eiffel Tower signals every day, these signals coming in very loud.

AMATEUR NOTES.

"WORDS" OVER "WIRELESS."

Under the above heading we published in our December number some comments on certain controversies which have been going on in one of our contemporaries. One of these referred to the working of certain "schools," which were, apparently, causing some interference with amateur stations in the neighbourhood of London. Our comment has brought us a very sensible and dignified letter from "EX-TELEGRAPHIST," who says: "I believe I opened the subject in a letter wherein I related my own experience of hearing two coast stations widely apart (GLV and GNF) asking amateurs to cease working as traffic was being delayed. In one case a threat to inform the police was made; in the other, I was surprised to find North Foreland could complain of a school near London. It appears from the subsequent correspondence that the schools worried the London area amateurs, and recriminations followed. . . ." He explains that his sole object—one with which we entirely sympathise—in drawing attention to the subject was to beg the amateurs to use every means and take every care to avoid interfering with the course of business carried on by coast stations, not only because it is obviously right that they should be careful in this respect, but for the more selfish reason that such interference, if it becomes a common occurrence, is bound to lead to the impositions of fresh restrictions on amateur transmission.

* * *

Among the amateurs to whom "EX-TELEGRAPHIST" appeals are included, naturally, those schools which, in the controversy following on his original letter, became the object of attack of other writers; and in this regard he concludes in his present communication: "Without detracting in any degree from the admirable work carried on by the schools, may I plead for a strict watch on their part to interfere as little as possible with the public traffic, and to guard zealously the amateurs' privileges?" With this plea, if it is necessary, we heartily concur. It is, of course, a truism to say that no one should be allowed to work a transmitting station who is not able to read Morse rapidly and accurately enough to learn at once if he is in any way interfering with traffic; and, of course, anyone who learns this and fails to attend to this information is unworthy to be allowed the "freedom of the ether."

* * *

Mr. H. W. Pope also writes to us concerning our comments, and we have pleasure in publishing his letter. He states:

"I have just received the December number of THE WIRELESS WORLD, and am very interested in your remarks concerning the letters of 'CQ' which appeared in a contemporary.

"While agreeing with your view that the training schools should retain the more or less free hand that they have enjoyed with regard to experimental signalling, I cannot agree with your disparaging remarks about the more sensitive crystals.

"Without any very 'careful adjustment' I have *always* been able to obtain good, strong, readable signals in London from most English coast stations, let alone 'five times out of ten,' with a detector, using Zincite and Bornite combination.

"As for crystal detectors going out of adjustment, I have often used a detector for several days without any need for readjustment; and, supposing it does go out of adjustment, it is only the work of two seconds at most to select a sensitive position on the crystal.

"The point to be observed in using hypersensitive crystals is to protect them properly during periods of transmission, which can be accomplished with the greatest of ease.

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"Having used the magnetic detector commercially for the last eight months, I am fully alive to its value as a reliable and 'foolproof' piece of apparatus, and probably of the most suitable nature for marine commercial work. This being so, intending operators have to be instructed in its use at the several schools that 'CQ' has his 'knife' into.

"Instead, however, of aiming blows at these useful institutions, why does not 'CQ' turn his attention to the capability of tuning out the undesired signals which his instruments should possess, as I am convinced that the tuning of those schools is good, and admits of their being tuned in and out quite easily; and, incidentally, the experience would be useful."

* * *

Mr. Pope has chosen a particularly good and reliable combination—Zincite-Bornite—for which we have the greatest respect. We should be sorry if we were thought to disparage crystal detectors *en masse*. Nothing could be further from our intention. It is true that we are in the habit of advocating the use of only one crystal (carborundum), but this is because we know by experience what an admirable detector this is when properly selected and used with a suitably designed circuit. The amateur, as a rule, takes his carborundum crystal at random, puts it in a circuit which is not suited to it, fails to get good results, and takes to some other far less reliable detector, under the impression that he has given carborundum a proper trial. Probably up to the present the greater number of amateurs have had no idea as to why or how a crystal performs its functions as a detector. Since our recent instructional articles, however, there is no excuse for any of our readers being at a loss to understand this important point, and they will be able to see that a carborundum crystal, for example, should be chosen with as much careful examination into its characteristics as, let us say, an applicant for a vacant post.

* * *

If the supply of carborundum ran out we think we should adopt our correspondent's combination. But the fact that he gets good reliable results with this detector in no way affects the case in point, and we see no reason to modify our remarks. Even in his expert hands we gather that with this particularly reliable combination an occasional "two seconds" is needed for readjustment, and these two seconds may easily come at a critical moment in commercial working; in fact, by the general law of pure cussedness they almost invariably do so time themselves. In conclusion, we may frankly admit that our mention, in the paragraph referred to, of one particular combination was due, not so much to a special vindictiveness towards this detector as to an æsthetic pleasure in the sheer beauty of its name.

* * *

Mr. W. J. Fry has also written to us from the rooms of the Wireless Society of London concerning other comments which appeared in our December "Amateur Notes." His letter has unfortunately been crowded out of this number, but, on second thoughts, we question whether its publication would serve any useful purpose. Recriminations such as those referred to by our correspondent, "EX-TELEGRAPHIST," seem to be rather popular in amateur wireless circles, and we should be sorry to encourage them to continue, which would be the effect of publishing Mr. Fry's letter to us.

* * *

A general meeting of the Wireless Society of London was held in the Lecture Hall of the Institution of Electrical Engineers, on January 21st, when the President (Mr. A. A. Campbell Swinton) delivered his inaugural address. By the courtesy of Commandant Ferrié, a Vice-President of the Society, the radio-telegraphic station of the Eiffel Tower, Paris, sent a special wireless message to the Society during the meeting, and arrangements were made to render the message audible to all present. The President's address was mainly concerned with a description of the means devised with the object of securing permanent records of wireless messages that could be taken down and read at leisure and of his own private installation. He predicted that if we were ever to have transatlantic telephony, it would be wireless.

* * *

A meeting of the Liverpool and District Amateur Wireless Association was held on

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January 13th, when the chair was taken by Mr. J. T. Matthews, of Chester. A member described the principles, construction, and working of the Wheatstone Bridge, and afterwards several interesting tests were made with a commercial pattern instrument. Miniature receiving outfits seem to be becoming very popular, and an interesting type made by one of the members was shown. Although wound with rather small gauge wire, this was stated to give quite satisfactory results. The automatic sending outfit designed by another member was also on exhibition, and there were various other apparatus and parts brought up for inspection and discussion. As a new session has just commenced, it is opportune for new members to join the association, and all persons interested in "Wireless" are cordially invited to apply for membership to Mr. S. Frith, 6 Cambridge Road, Great Crosby, Liverpool.

* * *

The Annual General Meeting of the Derby Wireless Club was held on January 7th, when there was a large attendance of members. Sir Henry Norman, M.P., was elected President for the ensuing year, Mr. A. Trevelyan Lee was re-elected Hon. Sec., Mr. Wm. Bemrose, Hon. Treas., and Messrs. Mart and Huson, Librarians. The following committee was appointed: Messrs. J. W. Downes, J. Lowe, W. Harris, K. S. Haslam, Drury, Canham and Bowles.

Mr. S. Grimwood Taylor, who presided, briefly reviewed the past year's working, and said they all regretted that amateurs would probably not be able to assist very largely with the British Association Radio Committee's scheme of observations. Sunrise, 11 a.m., and sunset, too, are impossible times for most amateurs, but they were all anxious to do whatever they possibly could. With reference to the annual fee likely to be charged for amateur licences, he hoped it would not be unduly prohibitive. A new Act of Parliament would have to be secured by the Postmaster-General in the forthcoming session, and every amateur in the country should join a club and endeavour by joint action to see they were not dealt with too severely. Only about two out of five amateurs belonged to clubs, and the other three were perhaps relying on the clubs to do all the wo- So far as he could see, nothing was likely to be done at all by either amateurs or clubs. They themselves had had no response to their suggestion of a conference, and had therefore dropped the matter altogether. Mr. Taylor also referred in eulogistic terms to the strenuous work done by Mr. Lee, to whose energy the Club mainly owed its strong position. During the past year two successful exhibitions had been held, and more or less amateurish experiments had been made with mirror galvanometers, Brown relays, cartwheel and disc tuners, kite and indoor aerials, and aerials lying on the ground. Two corresponding members had independently reported that "dummy" wires, in proximity to but not in metallic contact with indoor aerials greatly improved signals, but no one else seemed to have yet experimented on these lines. Local transmitting apparatus was of divers types, and an extended range had been achieved by Mr. Bemrose and Mr. Lee. Some discussion was going on regarding the merits of exceptionally fine wire for "aerial inductances." He had experimented with sizes, from No. 18 to 38, and preferred the larger sized wire. However, he did not consider the difference more than 5 per cent. A good pair of 'phones would easily make a difference of 95 per cent. Fleming advised many stranded wire. Mr. Lee, the hon. sec., reported that this was the third year of the Club's existence, and the membership, now over 100, had steadily increased. His multitudinous correspondence came from all parts of the world, India, South Africa, Jamaica, British Honduras, Buenos Aires, Australia and New Zealand, as well as Europe and the British Isles. There were no corresponding members this time last year, but now the number exceeded that of the local members. The hon. treasurer's report showed a good balance in hand, and it was decided to add Dr. J. A. Fleming's and books by other authors to the library.

* * *

A meeting of the Bristol Wireless Association was held on January 10th. The Rev. W. P. Rigby presided, and there was a good attendance of members. An interesting paper on "Wireless Makeshifts" was read, and was followed by discussion. Mr. A. C. Davies has promised to contribute a paper upon "Crystals" at the next meeting, the date of which is February 14th.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

P. C. (Aldershot) thanks us for our reply to his question, which he says has helped him greatly; he sends us a diagram of his receiving circuits as he has them now. But we still do not like them. He should try another way, putting his detector in series with his telephones and connecting the two across his tuning-coil. The blocking condenser is not necessary where shown; it might be put right across the telephones, though to get the best results it should be possible to vary the capacity in steps. For transmitting he uses a plain aerial, and wishes to know whether he could get a larger radius by making a jigger. He uses a one-inch spark coil. For small portable sets using very short waves plain aerial is very hard to beat, if well insulated (this is its weak point, especially in wet weather). He might try a jigger; he should find what is the largest capacity which his coil will charge and still give a spark of 1 mm. at least (this depends on the coil and cannot be prophesied from the mere "one-inch spark" datum). Then his jigger primary should be wound so as to give the required wave-length when combined with that capacity. A good ratio for the number of primary turns to the number of secondary turns is 1 to 7.

H. C. B.—Here are replies to remainder of your questions, the first four of which were dealt with in our December number. (5) I have read in "Instruction in Wireless Telegraphy" that a transmitting aerial will not work well with a wave-length more than twice the natural wave-length of the aerial. Does this apply to the receiving aerial as well? (6) Does not the diameter of the wire used for an aerial make a difference to its capacity? If so, why is this not taken into account in finding the natural wave-length of an aerial? (7) I also read in THE WIRELESS WORLD that the power of a station is proportional to the capacity of the condenser, the voltage to which it is charged and the number of times it is charged and discharged per second. Does this last factor have any effect on the range of the station? If so, why? Will you please give me the formula connecting those, and also the units they are in.

Answers.—(5) A receiving aerial works best when its natural wave-length is about three-quarters of the wave-length received, the other quarter being made up by the jigger-primary. As additional inductance is added to tune up to longer waves, the efficiency of the circuit diminishes; but—luckily for amateurs, who want to receive the "big stations" on their little aerials—the effect is not as marked as in the case of the transmitting aerial.

(6) Increase of diameter increases the capacity of a wire, but decreases its inductance; these effects more or less balance, so that the size of the wire has very little to say to its wave-length.

(7) The "power" of a station, here referred to, means the power required to transmit, and obviously depends, among other things, on the number of sparks produced in a second. At the receiving end each spark is heard separately (although the ear blends them into a note or a noise), so that with a telephonic receiver the actual *strength* of the signal is independent of the number of discharges, except in so far as the telephone itself responds more readily to a moderately rapid note than to a widely-spaced succession of "clicks." This, however, has a great effect on the *legibility* of the signals, especially through atmospherics or other interference. Things are altogether different if, instead of a telephonic receiver, we use some kind of integrating detector which sums up the effect of all the discharges contained in a "dot" or a "dash"; in this case the signal strength itself depends on the discharge-frequency.

C. S. S. (Hendon).—(1) What is the best cable to use for the lead in? It will touch the wall. (2) Will a twin-wire aerial with three insulators (each for 10,000 volts) fixed at each end of each wire, and one where the ropes meet, be sufficiently insulated for lightning and for 2-inch coil.

Answer.—(1) Much better to keep it clear of the wall on porcelain insulators, or cleats, using, say, 7/22 I.R.V.B. cable and leading-in either with some leading-in insulator or with a length of the high-tension lead used for motor-car ignition. (2) Plenty, if you are using a jigger; if plain aerial, you may have trouble in wet weather. Watch and see on a wet night.

QUERYMAN.—I have the following instruments set up: Aerials, height about 45 feet, and length about 40 feet; tuning coil, gauge 20 (double slider), 11 inches by 2¾ inches diameter; silicon detector, with brass point; condenser (tinfoil on glass), 12 inches by 12 inches outside, 9 inch by 9 inch tinfoil; and a receiver. A Post Office inspector who examined the installation said: "That to get Eiffel would be child's play, and Germany should be easily got." So far (three weeks) I have had no result, though once I "fancied" various sounds came through from Eiffel, but I fear atmospherics were more probable. Can you inform me approximately how my "sliders" would be for any length (say, 300 metres) wave? If a 600-metre wave is being used, how can I, roughly, tune for it? If both my "sliders" were half-way, what would the wave be tuned for?

Answer.—If the wire is really No. 20, we do not think you have nearly enough inductance to tune to the long waves in question. It would be all right for the short ship waves, etc. For long waves you had better try putting a fixed inductance of at least an equal value in series with it.

If you put both your sliders at the centre point it will be a miracle if you get any signals at all on any wave, for, according to your sketch, this would put your detector-circuit on the same turn as your earth-lead. Your whole arrangement of wiring-up is not at all good; we recommend you to study our Instructional Articles carefully, especially that in the November number. One thing you do not mention, of great importance, and that is the nature of your telephones; we suppose that these are suitable, but if they are not, this would account for everything. If they are, then we recommend you to: increase your tuning-inductance for the long waves; do away with the condenser for the present; put your telephones in series with your detector, and put the two directly across all your tuning-inductance—that is, from aerial to earth: the detector going to aerial and the telephone to earth. The aerial can go permanently to the upper end of the inductance, and one slider (the other can be neglected for the present) can go to earth. Thus you will have an aerial-earth circuit with a variable amount of inductance

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in it, and your detector will be shunted from aerial to earth with the telephones in series with it. If the worst comes to the worst, you should try a carborundum crystal with battery and potentiometer.

S. F. H. (Battersea).—(1) I have a two-slide inductance coil, 8 inches long, 2 inches diameter, and wound with about 300 feet of wire. How far would that step a 200-metre wave-length aerial up to? (2) I wish to make a coil with a switch with stops to be able to tune up to 4,000 metres. What wire (size, length) would I want, and what would be the best length between steps?

Answer.—(1) Impossible to say exactly; one aerial may be exactly the same as another so far as wave-length is concerned, but quite different so far as its inductance is concerned; and it is on this value that the wave-length produced by added inductance depends. If yours is a single-wire aerial, the coil you mention might tune up to about 1,700 metres; if it is a twin-wire (so that its own inductance is less and its capacity more), it would tune, with the same coil, to a longer wave. (2) Remarks on your first query apply here also. You would probably need something like an 8-inch diameter coil, 18 inches long, wound with wire giving 28 turns to the inch.

See reply to "Dens" in this number as to mode of tapping-off.

J. B. (Manchester) has read in Hawkhead's "Handbook of Technical Instruction" how a Marconi set is tuned to give a shorter wave than the natural wave of the aerial plus jigger-secondary, by means of a condenser *in parallel* with the jigger-secondary; and he wants to know why this plan is adopted instead of the more obvious one of putting a condenser in series with the aerial. It is because the latter plan would result in insulating the aerial from earth, so that lightning and the steady static accumulation on the aerial would have no path to earth. Also, from the nature of the connections to the receiving apparatus (using the earth-arrester as an automatic change-over switch) this plan would leave the condenser always in series with the aerial when used for receiving, and so make it necessary to add an extra amount of tuning-inductance to tune to longer waves.

W. V. H. (Shoeburyness).—I have constructed a small wireless station for receiving, the dimensions of which are as follows:—The aerial is a 4-wire, 35 yards long, with an average height of 30 feet above ground, with leads from centre. The earth wire is soldered to the water pipe. The apparatus is a variable inductance, jigger, variable condensers, silicon-gold detector and single 1,000 ohm telephone (diagram annexed). I get Paris, Norddeich and Cleethorpes loud, especially Paris, but cannot get Poldhu quite loud enough to read. Can you suggest any additions to my apparatus to make Poldhu readable? It is practically impossible to either lengthen or heighten my aerial. Would adding more wires be of much use? I also want to construct a wave-meter.

Answer.—We cannot be sure that you are in the habit of getting accurate tuning; can you so adjust to Poldhu that *any change*—either increasing or decreasing the wave-lengths of your receiving circuits—will cause a corresponding decrease in the signals? If you cannot, then you should increase your tuning inductances and jigger-coils until you *can*. Also you might try a tighter coupling between primary and secondary; and try a longer jigger-secondary and *a smaller variable condenser across it*; also, couple your jigger-primary only to that end of the jigger-secondary which goes to the telephone side of the crystal. Try also a carefully selected Carborundum crystal with battery and potentiometer, and make sure that you are working on the critical point of the crystal so that any adjustment of the potentiometer—whether forward or back—weakens signals. If possible, work with your aerial tuning condenser shorted and tune only on the inductance. You might also try converting your T aerial into an inverted aerial—thus lengthening its wave-length—choosing, if possible, such an end as to convert it into the right directional aerial for Poldhu. A few more wires would add slightly to its receptive powers, especially if you can space them well. Increase your earth by wires running under the aerial and just buried in the ground. A wave-meter consists essentially of a circuit of continuously variable wave-length (within certain limits), provided with a detector of some kind—usually a carborundum crystal and telephone—which will indicate when it is receiving the maximum amount of energy from the circuit whose wave is to be measured. A simple form of wave-meter consists of a fixed inductance (usually coils on a wooden former) across a variable condenser; telephones, in series with a crystal, are connected across the condenser, the fixed inductance is coupled loosely to some part of the circuit to be tested, and the condenser adjusted until a maximum of sound is heard in the telephones. The wave-length is then read off from the calibration curve of the instrument.

H. R. M. (Hornsey).—Is the shunt inductance necessary in the Marconi multiple tuner and is the instrument patented?

Answer.—By the words "shunt inductance" you refer, we suppose, to the long, highly-inductive coil which is permanently connected between earth and the side of the aerial-tuning condenser which goes—through the aerial-tuning inductance—to the aerial. For commercial working, at any rate, this coil is essential, for without it the aerial would be insulated from earth except when the aerial-tuning condenser happened to be short-circuited, and the result would be that the aerial would frequently become charged by a gradual accumulation of atmospheric electricity, which would reach a potential enough to puncture the condenser-dielectric or to spark across it and thus produce a noise in the telephones. The instrument is patented.

Answer.—M. V. (Hassocks).—With regard to your transmitting arrangements, as you have plenty of aerial-length to spare and are limited in your wave-length, we recommend you to use less turns in your jigger-secondary. Every foot of wire in this is roughly equivalent to 2 or $2\frac{1}{2}$ feet in the aerial so far as wave-length is concerned, but it does not radiate, and had therefore better be kept as short as possible, provided you can get tight enough coupling. If you make it, say, of four turns instead of ten, you will weaken your coupling; but you could tighten this again by bringing your primary nearer, especially if you wind the latter so that it could, if required, go right over the secondary. This, of course, would mean abandoning your plan of a flat helix. With four turns in your secondary you would be adding the equivalent of about 30 feet to your aerial. You want a 250-metre wave, so your aerial circuit (a four-wire aerial) should be about $\frac{250}{4 \cdot 5}$ metres long—*i.e.*, about 180 feet in all; that is to say, your aerial, apart from the secondary, should be about 150 feet long, *including the down-lead*. The plan we should suggest is as follows: Use your two masts for a long-distance receiving aerial, making this as long and high as possible, and four-fold as before. You cannot make it too long, if you are looking for the big stations. For transmitting, put up a T aerial to the 90 foot mast, at right angles to the big aerial, the arms of the T sloping down, not going to any mast but guyed-out by light lines (insulated, of course, from the arms of the T) going to stakes in the earth at a sufficient distance from the 90 foot mast to keep the ends of the T a good height from the ground. Thus you would have half a T aerial on one side of your mast, and half on the other; each half consisting of two wires forming the sloping arm and the down-lead; these two halves would be joined at the leading-in insulator, and would form a whole "twin" T aerial. Each half of the T would be about 90 plus 60 feet (the 60 feet being the sloping arm). By this arrangement the effect of the long aerial on the short would be reduced as much as possible. Your 70 watts should be suitable for such an aerial. Thanks for your kind remarks.

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S. F. J. (Thornton Heath).—Read carefully the back numbers of THE WIRELESS WORLD, especially the "Questions and Answers" pages and the instructional articles, and you will find therein all the information you ask for. We cannot repeat over and over again, our space is too valuable.

E. F. B. (Louth).—(1) Not altogether satisfactory, but will do. (2) Can see no possible advantage in this. We should prefer to see the far ends all separate and the near ends all joined. (3) Yes. But do not attach too much importance to statements about hearing signals 10 feet away. If you like, try to magnify your loud signals by inserting your 'phones in a tin canister of the right size; then you may be able to boast, too. (4) Efficiency of condenser depends on the dielectric, which you do not even mention. But in any case the condenser, in the position shown, is only used as a makeshift if you have not enough tuning-inductance to put in your aerial circuit. If you have enough, you are better without the condenser. You might try transferring it to across your telephones. Tubular and vane condensers equally effective. ·00088 microfarad for every square metre of air-gap 1 centimetre thick. (5) How can we possibly tell? You should arrange matters so that you can tighten your coupling until signals begin to *decrease* again; thus you can find the position for strongest possible signals. (6) Two-circuit jigger or else an auto-jigger. Your aerial, with jigger-secondary, will give somewhere about 200 metres. You could reduce by capacity in series if necessary. Yes, or some Leyden jars. (7) Buy two cheap electric bells, remove hammers and gongs, and alter connections so that one may drive the other, the contacts of the latter being entirely free from the battery-circuit. Then use these contacts as a "ticker."

G. A. J. (London, N.).—We do not like your connections at all. Read our instructional articles, especially the November instalment. Your tuning-coil is not enough to tune to the big stations, but should give you the local small ones. But, in any case, your 100 ohms telephones would spoil your results: they are not nearly sensitive enough—unless you use an old ignition-coil as a telephone-transformer. Read our back "Questions and Answers" columns.

"ZETA."—Your connections seem to us terribly complicated and not altogether right. Why not remodel according to our November Instructional article? If you want to get uniform results we advise you to use carborundum, with battery and potentiometer, and make sure that you have so much battery-voltage that you can weaken signals by moving your potentiometer-slider in *either* direction—*i.e.*, increasing or decreasing the applied voltage. With regard to your getting no comparatively short waves (such as ships' waves) read our answer to W. E. D. in this number.

W. E. D. (Brighton).—I am unable to "pick up" signals upon my wireless set from other small stations within a mile or two although the signals I receive from most of the large stations are very plain and distinct, especially G.N.F., which is but seven miles away. The particulars of my installation are as follows: Receiving apparatus, tuning coil, two sliders, 16 inches by 5 inches, but only using one at present, with silicon gold point detector and telephones 2,000-watt each, with small blocking condenser in shunt.

Answer.—The small stations are working with waves about 200 metres long, or less, and your apparatus is quite unsuitable for these. Amateurs do not seem to realise that crystal receivers must be connected to a point of high voltage. Now, when an aerial circuit is resonating to an incoming wave, it has maximum voltage at the top of the aerial and minimum voltage at the earth-lead. So that to use a crystal direct-coupled (*i.e.*, without a jigger), it should, theoretically, be put at the top of the aerial! The only reason why amateurs can get good results by connecting their crystal direct to the aerial-circuit, at the foot of the aerial, is that they are generally trying to receive waves which are enormously long compared to their aerials, so that they have a very large amount of tuning-inductance in series with the aerial, and the potential at the upper end of all this inductance is almost as great as at the top of the aerial itself. When, however, the amateur tries to receive short waves, his own aerial is nearly in tune with them without any extra inductance, and the small amount of inductance required to put it into tune does *not* give the high potential required for the crystal. In such a case two things can be done: either the aerial wave-length can first be reduced by a small condenser *in series*, and a large amount of inductance then added to make up the wave-length required, the crystal being connected to the top end of this inductance; or, better, a small short-wave receiving jigger can be wound. This should have a short primary at one end of a long secondary, the upper end of the secondary giving the high potential and, therefore, going to the crystal. In its simplest form it might be an "auto-jigger" consisting of a single coil (much smaller than yours), a few of the lower turns forming the primary and the whole coil forming the secondary.

C. N. S. (Kingston).—(1) Your first calculation is quite correct; the frequency of the 300-metre wave is one million per second. Your difficulty in reconciling this to the other formula is due to the fact that in the latter one of the *units* is different. If a thing costs *one* pound we can say that its price is *twenty* shillings, but we cannot say that 1 = 20. In the first formula the capacity is measured in microfarads and the inductance in microhenries; in the second, the capacity is still in microfarads, but the inductance is measured in centimetres of inductance. Now, since 1 microhenry = 1,000 centimetres of inductance, and the factor "L" comes under the square root sign, you must divide your second result by the square root of a thousand—*i.e.*, by about 31. (2) A receiving aerial gets its energy from the comparatively small portion of the electro-magnetic field immediately surrounding it. In the case, at any rate, of the ordinary transmitting aerial the waves are sent out in all directions in the form of ever-widening circles, and those waves which find no receiving aerial to absorb them pass on and gradually waste themselves. Hence, unless one receiving aerial is so close to another that they both attempt to drain the same small portion of the æther, the presence of the one has no effect on the other.

"DENS" (Brighton) has rewound his tuning inductance (which was formerly one with sliding-contact) so as to use tappings going to a pair of multi-contact switches, using the same wire which formed the original coil. He now finds the disconcerting fact that the coil has in its present condition the power to tune up to 2,000 metres only, whereas in its old state it would tune up to 4,000 metres easily. His suggestion that the bared parts (where the insulation was removed for the sliding-contact) are causing many of the turns to short-circuit seems as good as any we can suggest for the explanation of this strange phenomenon, since he is quite sure that the tappings and switches are free from short-circuit; yet even this explanation fails to appeal to us, since, after rewinding (of course, in a single even layer), the bared places are really less likely to agree with, and touch, each other than before rewinding. His system of tappings (on which he asks an opinion) is the well-known and effective one in which the twenty contacts of the first switch go to the first consecutive twenty turns of the coil, while the twenty contacts of the second switch go one to every twentieth turn of the rest of the coil, which is not further subdivided. As drawn and lettered in his diagram, the maximum number of turns is *not* included when the numbers on the switches show a maximum; this, of course, if actually the case, might explain his strange results, but we can hardly think that it is anything but an error in drawing. The wave-length to which a given coil will tune an aerial depends, of course, on the aerial itself; but if "Dens'" aerial is at all an average one, with a natural wave of, say, 200 metres, we should be rather surprised to find the coil he describes tuning it up to 4,000 metres or more.

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Marconi House Notes

FOOTBALL SECTION.

Quit the great event of the football season took place on Saturday, 17th—viz., the match between the Marconi Club and the Oratory Brigade, a direct contest for the leading position in the Western Suburban Alliance. Unfortunately the Marconi Club, though supported by a large number of adherents among the onlookers, and in spite of brilliant play by Ralph Williams and F. Lord, lost by 3 goals to nil.

CRICKET SECTION.

A general meeting of the cricket section was held on January 12th for the election of officers for the coming season. Mr. R. Williams was appointed captain of the first and Mr. Stokes of the second eleven.

THE TENNIS SECTION.

The committee of the Tennis Section are now arranging for the improvement and extension of the tennis courts. Hearty and muscular young men who want genuine exercise are invited to place their arms at the disposal of the committee on Saturdays (for gang work, to assist in the redistribution of the earth's crust).

MUSICAL SOCIETY.

The band contest between the Marconi House Orchestra and the Chelmsford Works Orchestra has been fixed to take place on Saturday, February 21st. Mrs. Godfrey Isaacs has consented to be the judge, and both bands are now working hard to fit themselves for the event.

DEBATING SOCIETY.

The gap in the social associations pointed out by Capt. Sankey at the Marconi dinner has speedily been filled in by the formation of a Debating Society. On Thursday, 8th, it was inaugurated, and the first debate took place the following Thursday.

With Mr. Rattray in the chair, Capt. Sankey opened with a thoughtful and well-balanced address on National Military Service. The debate which followed, if a little lacking in definition, was both interesting and well sustained, revealing several promising debaters and permitting great hopes for the future.

Patent Record.

The following patents have been applied for since we went to press with the January number:

1913.

28,277 & 28,278. December 8th. Wm. H. Shephard and A. E. McKechnie. Line or wireless telegraph systems.

28,409. December 9th. Fred G. Sargent. Wireless telegraphy.

28,413. December 9th. Marconi's W. T. Co., Ltd., and H. J. Round. Receivers for use in wireless telegraphy.

28,602. December 11th. Egmont C. Hoegerstaedt and Harold S. Westcott. Wireless telegraphy.

28,839. December 13th. Olaf Pedersen. H.F. electric current generators.

29,447. December 20th. Josef Schiessler. Apparatus suitable for use in wireless telegraphy or telephony.

29,711. December 24th. John D. L. Bradwell and Geo. Bradwell. Radio-telegraphic or like receiving apparatus.

29,712. December 24th. Roberto C. Galletti. Transmission of wireless signals.

29,902. December 29th. Adrian F. Sykes. Generator of electrical oscillations.

29,946. December 30th. Graf Georg von Arco and Alexander Meissner. Transmitting arrangement for wireless telegraphy and telephony.

1914.

194. January 3rd. Ernest Wilson. Detector for radio-telegraphy or telephony.

252. January 5th. Graf Georg von Arco and Alexander Meissner. Relay arrangements for wireless telegraphy and telephony.

440. January 7th. Percy A. E. Armstrong. Call-up switch for wireless telephones.

739. January 10th. Arthur Booth Webber and the Standard Time Co., Ltd. Device for prolonging the period between the active intermitting electric impulses.

Personal Items.

Mr. René Demont, the representative of the Marconi Company in Bolivia, was recently married in Paris to Miss Virginie Sappen of that city.

In the Scottish Wireless Signal Company, Royal Engineers, Capt. W. C. Easton (from the Scottish Airline Signal Company) has been appointed captain.

On December 24th, 1913, the Marconi Wireless Telegraph Company of America, of which Mr. E. J. Nally is vice-president and general manager, entertained many invited guests and its officials and employes at a Christmas celebration at its offices in the Woolworth Building, New York. There were about 100 persons present, and an enjoyable hour was spent. A luncheon was served, after which "Santa Claus" came in by wireless, and distributed presents to many of those in attendance.

Obituary.

Dr. Henri Simon, Chief of the Radio-telegraphic Service of Switzerland, and a pioneer in the use of X-rays, died at Geneva recently, a victim of these rays. He had endured many surgical operations, having lost one arm and part of the other.

BOOKS on Wireless Telegraphy, also all other Subjects; Secondhand at Half Prices. New 25% Discount. Catalogues Free. State Wants. Books sent on Approval. Books Bought. W. & G. FOYLE, 121-123 Charing Cross Road, London.

MESS UNIFORM and dozen white suits, almost new (height 5 ft. 9½ in.), for sale by late operator.—BEATTIE, 27 Broadhurst Gardens, Finchley Road, N.W.

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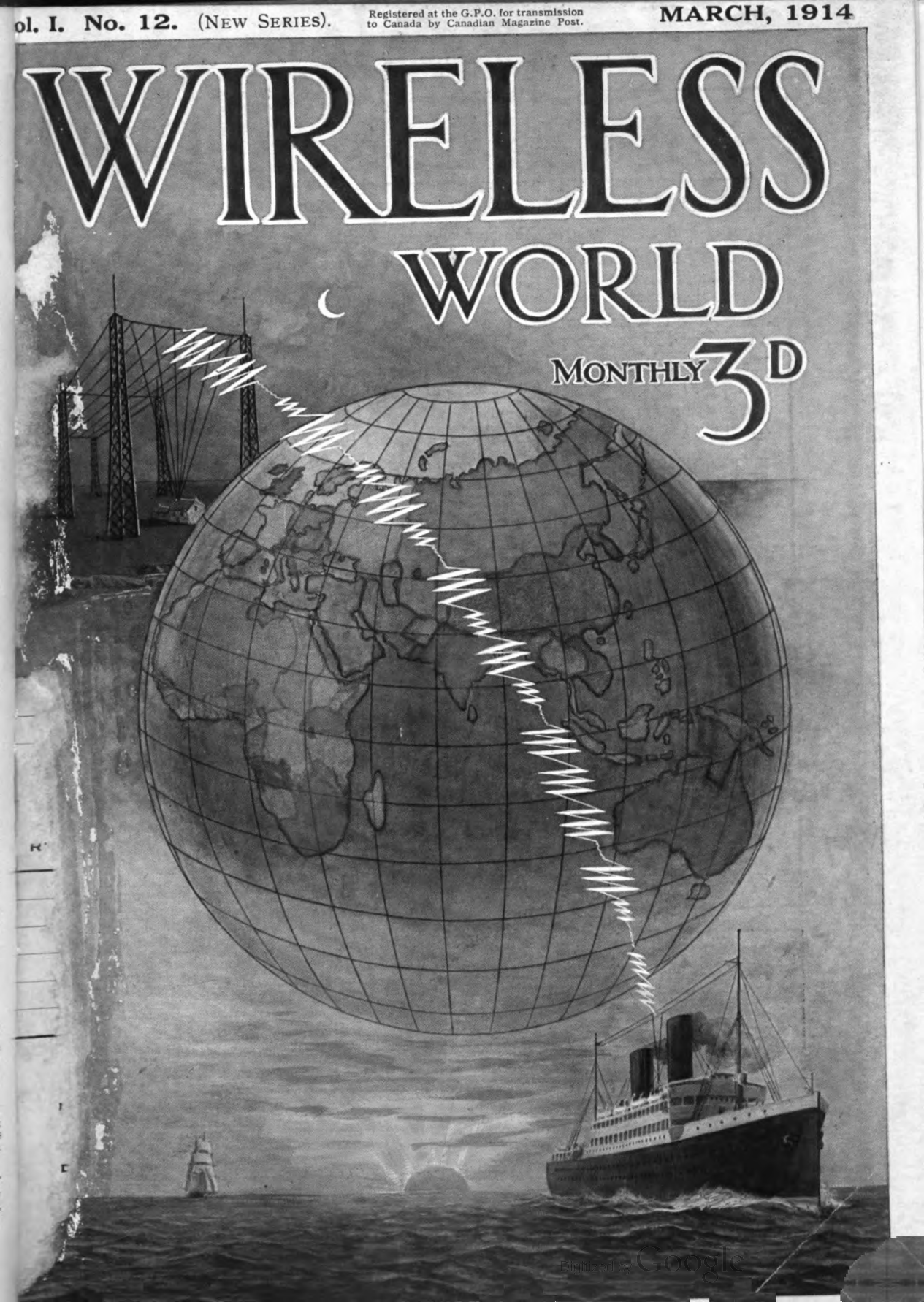
WIRELESS WORLD

MONTHLY 3D



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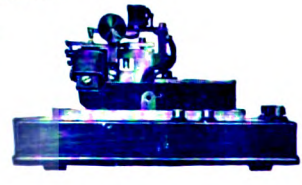

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The Wireless World.

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The Editor will be pleased to receive contributions; and illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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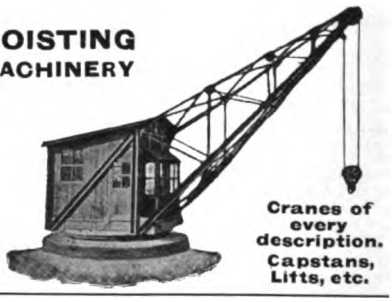

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THE
WIRELESS WORLD
with which is incorporated
The MARCONIGRAPH

Vol. 1.—No. 12. (New Series) March, 1914. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

Wireless and Aircraft

ALTHOUGH little has been published recently concerning the application of wireless telegraphy to aircraft it would be a mistake to suppose that nothing is being done in this direction. The main lines upon which this branch of wireless telegraphy will be developed are now clearly understood, and by co-operation with the designers and owners of aeroplanes in the making of the necessary tests we should be within measurable distance of standard wireless equipments which will be to aeroplanes what wireless sets are to ships.

The reticence which has been shown in this matter is quite excusable, as we do not think it helps the public to a clear understanding of wireless progress—by which we mean progress that is calculated to extend the practical application of wireless telegraphy to the requirements and benefits of mankind and mankind's many-sided activities—to herald as advances such achievements as have been gained under the ideal conditions existing in a laboratory and which have not yet emerged successfully from the practical tests made under ordinary, every-day commercial conditions.

It has been an open secret, however, that the question of designing wireless telegraph apparatus for aircraft has engaged the closest attention of the Marconi Company, and it is gratifying to report that such progress has been made that experiments to be carried out at Hendon will demonstrate the degree of success obtained. It is generally believed that this branch of wireless telegraphy has not progressed much beyond the elementary stage; but this is not a correct belief; for one thing the increasing range of the aeroplane has made an improved system essential, and there is good ground for supposing that the new apparatus now being designed will meet the demands of the naval and military authorities.

One of the great drawbacks of the aeroplane wireless apparatus is weight. The present apparatus is equal in weight to that of an average passenger, which, of course, is an important disadvantage. To reduce the weight of the apparatus without sacrificing efficiency is one of the difficult problems to be dealt with, but it is not an insoluble problem. Another problem lies in the wires, which have to be trailed out behind an aeroplane in flight in order to detect messages. There is always the possibility of these wires becoming entangled in the propeller and bringing disaster, especially in the case of machines where the screw is behind the pilot and not in front, as in the tractor type. The solution of this problem would appear to lie in the substitution for the long trailing wires of shorter aerials, probably fixed wires between the planes and the tail.

In receiving messages in the air operators are also at a disadvantage, as the thunder of the engine makes it difficult at times to hear the signals, but with the design of a suitable sound-proof helmet this difficulty should soon be overcome.

That the difficulties will be solved we have no manner of doubt, and once they have been overcome it is manifest that the usefulness of the aeroplane, particularly for military and naval work, will be very greatly extended. In fact, a really reliable wireless installation suitable for such work would increase the value of scouting aircraft out of all knowledge.

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MR. GEORGE MORRIS BOSWORTH

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Personalities in the Wireless World

GEORGE MORRIS BOSWORTH

Vice-President of the Canadian Pacific Railway, Director of the Marconi Wireless Telegraph Company of Canada

IT is, of course, only natural that a corporation like the Canadian Pacific Railway, with world-wide activities and interests, requires men of the highest possible integrity to guide its affairs; moreover, in the service of such a company the best men are bound to rise up to the highest positions, because there is every opportunity for a capable man to prove his worth. In Mr. George M. Bosworth we have a living example of the way in which, by merit and industry, a man may rise from the ranks to a commanding position.

George Morris Bosworth was born at Ogdensburg, N.Y., in the year 1858, and, like many other great transportation officials, has been connected with railways and shipping from his earliest years, for in 1875 he entered the service of the Ogdensburg and Lake Champlain Railroad, in the comparatively short space of six years obtaining appointment as General Freight Agent to the company. Some men would have been content with a position of that kind, but not so Mr. Bosworth. He wanted fresh experience and a wider field for knowledge, so for a short time he accepted service as Travelling Freight Agent with the National Despatch Line of Chicago. In 1882 he commenced what has proved to be his life work by becoming Assistant General Freight Agent for the Eastern Lines of the Canadian Pacific Railway when the line was very much in its infancy, and in the opinion of many men would never grow up. The railway traffic increased rapidly with the development of Canada, which followed immediately on completion of the line from Atlantic to Pacific, and before many more years had elapsed Mr. Bosworth was appointed General Freight Agent for the Eastern Division. Still the railroad continued to extend its scope, steamship services under its management were commenced, at first on the Pacific from Vancouver to China and Japan, afterwards from European ports to Canada. Ultimately they provided direct communication almost half round the globe, and brought a gigantic increase in traffic, which required an expert to guide and control the immense volume of freight entrusted to the company's care. Mr. Bosworth was the expert who eventually took control of this branch of the company's activities on his appointment as Freight Traffic Manager for the whole system. A yet wider field was given to Mr. Bosworth by his appointment as Fourth Vice-President to his company in the year 1901. His exalted position further proved his great administrative capacity, for the Canadian Pacific by the extension of its activities over so vast a field of enterprise requires a man at the head of affairs who can deal with difficult and varied questions.

Since the year 1910 Mr. Bosworth has held a yet higher appointment with the company. As Vice-President, he is one of Sir Thomas Shaughnessy's right-hand men, and it may safely be said that there is not a single interest or section of the great organisation which does not in some way or other come under his jurisdiction, for he is a veritable corner-stone in the wonderful institution known the world over by the three letters "C.P.R."

Mr. Bosworth's activities do not end with his official duties to the C.P.R.; he is a Director of the Marconi Wireless Telegraph Company of Canada, the Dominion Dry Dock Company, the Crown Trust Company, La Banque Provinciale, as well as Vice-President of the Canada Club, Montreal. One might well wonder how it is possible to keep in touch with such numerous branches of commerce, but that is where the genius of the man asserts itself, for it is most manifest in an extraordinary capacity for assimilating facts and disposing of knotty problems with astonishing rapidity.

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New Marconi Stations in Spain

"WIRELESS" never tarries; just as the ether wave charged with a message spreads itself out through space in swift eddies of invisible light and inaudible sound, so the "Marconi Organisation" is making its way into all parts of the world, covering land and sea with a network of communication which is as splendid in its achievement as it is magnificent in conception.

Finisterre, Santander, and Cape Palos must now be marked on the reader's map of the world with a sign which denotes the existence of a wireless station. All three stations are now in working order, and have been subjected to exhaustive tests by a Commission appointed by the Director-General of Spanish Posts and Telegraphs, and the report submitted by this Commission expressed unqualified approval at the splendid results obtained during the examination.

Of the three stations, Finisterre is the most important generally, on account of its strategical position, for it is the most westerly headland of Spain on the coast of Galicia.

Finis Terrae was the name given by the Romans to this prominency of the Ibernian Peninsula, and even to-day it well applies, for the voyager thither cannot but feel himself at the Land's End, so cut off is this corner of the earth from the civilised world. To reach the new station is a journey of 500 miles by rail from Madrid to Corunna, 60 miles by motor from Corunna to Corcubion, a picturesque little seaport situated at the end of Finisterre Bay, with a final 10 miles to be covered as best one may; and it is a very rough best, for the only progress is by narrow mountain paths for at least two of these miles. Yet it is sufficient compensation for the tiresome journey to reach the mountain top where the Station is situated, for what a glorious view lies stretched out beneath!

On the way across Galicia the traveller passes through a country broken into lofty mountains and deep valleys, mountain

The Station at Santander, with the waters of the Bay of Biscay washing its base.

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chain succeeding mountain chain in rhythmic beauty till at last Finisterre is reached, and there beneath lies the vast Atlantic, pitting its fury against the rocky vastness of the Cape or stretching out in exquisite calm with its crystal surface reflecting the incomparable blue of a Southern sky. At the foot of the mountain, sheltered from the fierce sou'-westers, lies the little fishing village of Finisterre. Once the inhabitants felt themselves to be forgotten and of no account, but to-day they are awakened up to an active interest in life, for *O Marconho* (the Marconi—for thus do they speak of the new Station) has brought them into the whirlpool of life, and has given to the little village where they have spent all their lives a greater prominence in affairs than ever it boasted of before.

Cape Palos Station, situated on one of the most prominent capes in the East of Spain. To the right is the Lighthouse.

The *Gallegos*, as the inhabitants of Galicia are called, are an astute folk, and keep themselves very much to themselves. The lower orders are not above undertaking the most menial of offices, and for this the Spaniards of other districts, who pride themselves on being more "enlightened," consider the Gallegos an inferior race. In spite of popular prejudice, however, many of the natives of these parts hold the highest positions in the Spanish intellectual world, and as proof of this it may be mentioned that several Ministers forming the late Liberal Cabinet were Gallegos. They are noted for enterprise and a taste for adventure, for their patriotism, and for their thrift.

The Finisterre wireless station has been erected on the summit of a mountain, a step rendered necessary in order to obtain for the station a maximum freedom from "screening" by adjacent mountains and fully justified by the excellent results obtained, although increasing to a great extent the difficulties of construction.

It will be readily appreciated that these difficulties have been of some magnitude when it is mentioned that all the plant and building material, with the exception of such stone as was quarried near the site, had to be landed by lighters at the primitive wharf of Finisterre and carted to the site by oxen over a route which even a great stretch of the imagination could not call a road.

The station is of stone, a construction called for by the Government concession, and rendered particularly necessary in this case by the tempestuous nature of the weather that prevails here.

The offices and plant are housed in a building separate from that used for living

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quarters, and in this manner operators off duty can take their rest without being unduly disturbed by the "wireless," and the operator on duty is rendered equally immune from disturbance. The two buildings are separated, however, only by a *patio* or yard about 20 feet square, so that all hands are within easy call in case of necessity; access from one building to the other being an easy matter, even in bad weather.

The living quarters contain a dining-room, five bedrooms, kitchen, etc., and are intended to provide accommodation for three wireless operators and one land-line operator.

The operating house consists of the engine room, battery room, "spark" or transmitting room, operating room and land-line office.

The prime source of energy is a 10 h.p. petrol engine direct coupled to a dynamo; the latter being employed to charge a battery of sixty 280 ampère-hour accumulator cells.

The transmitting set is of the standard 5 kw. "battleship" type with disc discharger, a description of which it is unnecessary to give here.

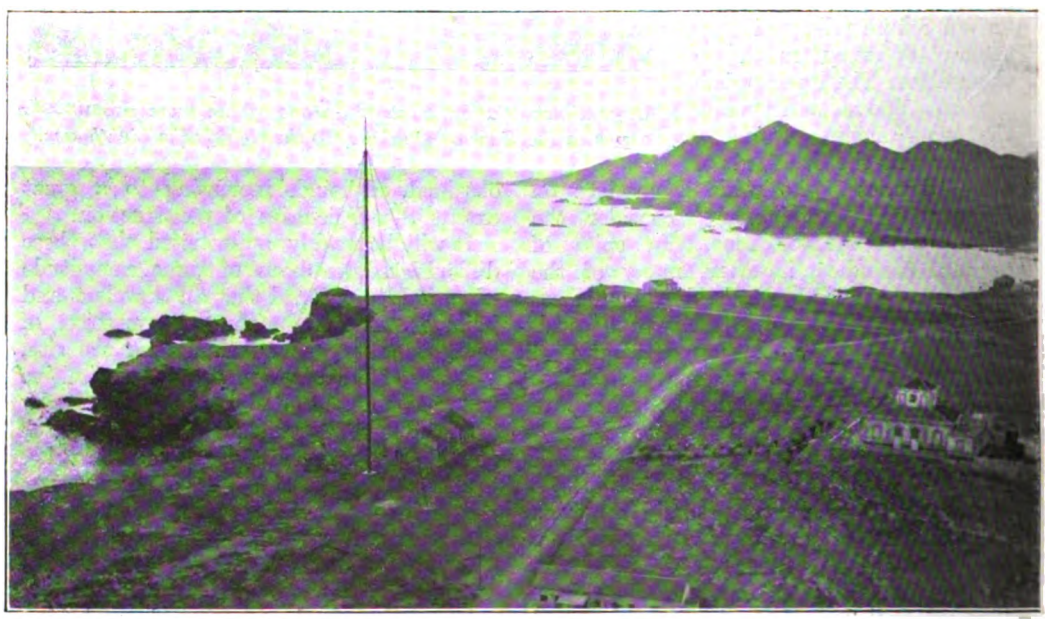
The operating room contains a magnetic detector with its multiple tuner and also the latest type of valve and crystal receivers. The operator, when seated at his desk, has within easy reach of his right hand all the necessary switchgear for controlling the motor-generator.

The land-line office contains the necessary telegraph instruments for working the wire connecting the station with Corunna. The exchange of telegraph forms between the wireless and land-line operators is effected through a small window, without either operator leaving his seat.

The aerial is of the four-wire "umbrella" type and is supported by a 220-feet sectional steel mast, the wire stays of which are amply insulated to prevent loss of energy in them due to induction.

The "earth" consists of eighty galvanised iron sheets 6 feet by 3 feet buried in the ground and connected to the operating house by copper wires.

Finisterre, in spite of its isolated position, is about to become the proud possessor of an electric power supply, and arrangements have already been made for utilising this supply for running the plant of the wireless station. A 6,000-volt transmission line will be run into the station, where the



A panoramic view of Cape Palos, with the Marconi Station in the foreground. It is a which separates the two is

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pressure will be transformed down to 220 volts. A three-phase induction motor will be installed and coupled by belt to the wireless motor-generator.

Similar in almost every respect to this station is the one which has recently been opened at Santander.

Santander, one of the principal provinces of Castille—cradle of the Spanish race—is generally referred to by Spaniards as *La Montana* (the mountain), on account of the fact that it extends right over the broken counterforts of the Pyrenees, whose sloping northern side projects its cliffs into the turbulent Bay of Biscay.

On one of these cliffs—Cabo Mayor—facing the Magdalena Palace, a new summer residence of the King and Queen, the Marconi station has been erected.

The third station is situated at Cape Palos, about sixteen miles from Carthagena, which boasts one of the finest naval harbours in the world.

Carthagena is also the centre of an intensely active mining and industrial district. Its arsenals, its foundries, its factories, with their smoking chimneys, tell of the reincarnation of this people who, cured to a certain extent of their inordinate fondness for politics, are beginning to direct their energies towards industry, the only true source of prosperity.

But there are no suburban or small industrial centres in Spain. The transition from manufacturing to agricultural districts is swift and surprising, so that the traveller who journeys further afield than Los Blancos, the limit of the industrial zone, is unprepared for the tranquillity which seems to pervade the vast fields that succeed, luxuriant in the rich vegetation of palm and cactus.

Cabo de Palos, to give it its correct name, is one of the most prominent capes on the east coast of Spain. It has no great elevation above the level of the sea, yet one obtains from it a truly magnificent view. On one side we have the Mar Menor or Lesser Sea, a beautiful lake separated from the Mediterranean by a neck of land fifteen miles long and some hundred yards in width, and, for the rest, almost completely surrounding the Cape, the Mediterranean itself—blue and peaceful.

Close by is the tiny village of Palos. Its inhabitants view with lively satisfaction the installation in their midst of this new Marconi station, which will render much beneficial service to the shipping of all nations in the Mediterranean.

magnificent view : on the one hand is the Mar Menor on the other the Mediterranean. The isthmus only about one hundred yards wide.

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Safety of Life at Sea

Compulsory Wireless Telegraphy

THE text of the Convention which was agreed upon at the International Conference on Safety of Life at Sea, and which was signed in London on January 20th, was issued in the form of a Blue Book on February 16th. The official text is in French, but the Board of Trade has accompanied that text by a translation for convenience of reference. It is pointed out, however, "that the French text is the only one which possesses any official authority." The Conference agreed that the text should not be published until the middle of the present month, so that the Delegations of the various contracting States might have time to communicate it to their respective Governments, but an outline of the principal results achieved was given in a speech in which Lord Mersey, the Chairman of the Conference, moved the adoption of the Convention. The Convention itself comprises seventy-four articles, with fifty-two supplementary articles embodying the regulations. The attention of the Governments of the contracting States is drawn to the desirability of making every effort to reduce delays for the installation of radiotelegraph apparatus, and the provision and training of operators for the different classes of ships dealt with in the Convention.

Chapter V., which deals with radiotelegraphy, is as follows :—

ARTICLE 31.—All merchant ships belonging to any of the Contracting States, whether they are propelled by machinery or by sails, and whether they carry passengers or not, shall, when engaged on the voyages specified in Article 2, be fitted with a radiotelegraph installation if they have on board fifty or more persons in all.

Advantage may not be taken of the provisions of Articles 2 and 3 of this Convention to exempt a ship from the requirements of this Chapter.

ARTICLE 32.—Ships of which the number of persons on board is exceptionally and temporarily increased up to or beyond fifty as the result of *force majeure*, or because the master is under the necessity of increasing the number of his crew to fill the places of those who are ill, or is obliged to carry shipwrecked or other persons, are exempted from the above obligation.

Moreover, the Governments of each of the Contracting States, if they consider that the route and the conditions of the voyage are such as to render a radiotelegraph installation unreasonable or unnecessary, may exempt from the above requirement the following ships :—

(1) Ships which in the course of their voyage do not go more than 150 sea miles from the nearest coast.

(2) Ships on which the number of persons on board is exceptionally or temporarily increased up to or beyond fifty by the carriage of cargo hands for a part of the voyage, provided that the said ships are not going from one continent to another, and that, during that part of their voyage, they remain within the limits of latitude 30° N and 30° S.

(3) Sailing vessels of primitive build, such as dhows, junks, etc., if it is practically impossible to instal a radiotelegraph apparatus.

ARTICLE 33.—Ships which, in accordance with Article 31 above, are required to be fitted with a radiotelegraph installation are divided, for the purpose of radiotelegraph service, into three classes, in accordance with the classification established for ship stations in Article XIII. (*b*) of the Regulations annexed to the Radiotelegraph Convention, signed in London on July 5th, 1912, viz. :—

First Class.—Ships having a continuous service.

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There shall be placed in the First Class ships which are intended to carry twenty-five or more passengers :—

(1) if they have an average speed in service of fifteen knots or more :

(2) if they have average speed in service of more than thirteen knots, but only subject to the two-fold condition that they have on board two hundred persons or more (passengers and crew), and that, in the course of their voyage, they go a distance of more than five hundred sea miles between any two consecutive ports. Nevertheless these ships may be placed in the Second Class on condition that they have a continuous watch.

Second Class.—Ships having a service of limited duration.

There shall be placed in the Second Class all ships which are intended to carry twenty-five or more passengers, if they are not, for other reasons, placed in the First Class.

Ships placed in the Second Class must, during navigation, maintain a continuous watch for at least seven hours a day, and a watch of ten minutes at the beginning of every other hour.

Third Class.—Ships which have no fixed periods of service.

All ships which are placed neither in the First nor in the Second Class shall be placed in the Third Class.

The owner of a ship placed in the Second or in the Third Class has the right to require that, if the ship complies with all the requirements for a superior class, a statement to the effect that it belongs to that superior class shall be inserted in the Safety Certificate.

ARTICLE 34.—Ships which are required by Article 31 above to be fitted with a radiotelegraph installation shall be required, by the Governments of the countries to which they belong, to maintain a continuous watch during navigation as soon as the said Governments consider that it will be of service for the purpose of safety of life at sea.

Meanwhile, the High Contracting Parties undertake to require, from the date of the ratification of the present Convention, subject to the delays specified below, a continuous watch on the following ships :—

(1) Ships whose average speed in service exceeds 13 knots, which have on board 200 persons or more, and which, in the course of their voyage, go a distance of more than 500 sea miles between two consecutive ports, when these ships are placed in the Second Class.

(2) Ships in the Second Class, for the whole of the time during which they are more than 500 sea miles from the nearest coast.

(3) Other ships specified in Article 31, when they are engaged in the Trans-Atlantic trade, or when they are engaged in other trades if their route takes them more than 1,000 sea miles from the nearest coast.

Ships connected with all kinds of fishing business, including whaling, which are required to be fitted with a radiotelegraph installation, shall not be required to maintain a continuous watch.

The continuous watch may be kept by one or more operators, holding certificates in accordance with Article X. of the Regulations annexed to the International Radiotelegraph Convention, 1912, together, if necessary, with one or more certificated watchers. Nevertheless, if an efficient automatic calling apparatus is invented, the continuous watch may be maintained by this means by agreement between the Governments of the High Contracting Parties.

By "certificated watcher" is meant any person holding a certificate issued under the authority of the Administration concerned. To obtain this certificate, the applicant must prove that he is capable of receiving and understanding the radiotelegraph distress signal and the safety signal described in the Regulations annexed hereto.

The High Contracting Parties undertake to take steps to ensure that the certificated watchers observe the secrecy of correspondence.

ARTICLE 35.—The radiotelegraph installations required by Article 31 above shall be capable of transmitting clearly perceptible signals from ship to ship over a range of at least 100 sea miles by day under normal conditions and circumstances.

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Every ship which is required, in conformity with the provisions of Article 31 above, to be fitted with a radiotelegraph installation, shall, whatever be the class in which it is placed, be provided in accordance with Article XI. of the Regulations annexed to the International Radiotelegraph Convention, 1912, with an emergency installation, every part of which is placed in a position of the greatest possible safety, to be determined by the Government of the country to which the ship belongs.

In all cases the emergency installation must be placed, in its entirety, in the upper part of the ship, as high as practically possible.

The emergency installation includes, as provided by Article XI. of the Regulations annexed to the International Radiotelegraph Convention, 1912, an independent source of energy capable of being put into operation rapidly and of working for at least six hours with a minimum range of eighty sea miles for ships in the First Class, and fifty sea miles for ships in the two other Classes.

If the normal installation, which, in accordance with this Article, has a range of at least one hundred sea miles, satisfies all the conditions prescribed above, an emergency installation is not required.

The licence provided for in Article IX. of the Regulations annexed to the International Radiotelegraph Convention, 1912, may not be issued unless the installation complies both with the provisions of that Convention and also with the provisions of this Convention.

ARTICLE 36.—The matters governed by the International Radiotelegraph Convention, 1912, and the Regulations annexed thereto, and in particular the radiotelegraph installations on ships, the transmission of messages, and the certific tes of the operators, remain and will co.n inue subject to the provisions :—

(1) of that Convention and the Regulations annexed thereto, of any other instruments which may in the future be substituted therefor.

(2) of this Convention, in regard to all the points in which it supplements the aforementioned documents.

ARTICLE 37.—Every master of a ship who receives a call for assistance from a vessel in distress is bound to proceed to the assistance of the persons in distress.

Every master of a vessel in distress has the right to requisition from among the ships which answer his call for assistance the ship or ships which he considers best able to render him assistance, but he must exercise this right only after consultation, so far as may be possible, with the masters of those ships. Such ships are then bound to comply immediately with the requisition by proceeding with all speed to the assistance of the persons in distress.

The masters of the ships which are required to render assistance are released from this obligation as soon as the master or masters requisitioned have made known that they will comply with the requisition, or as soon as the master of one of the ships which has reached the scene of the casualty has made known to them that their assistance is no longer necessary.

If the master of a ship is unable, or considers it unreasonable or unnecessary, in the special circumstances of the case, to go to the assistance of the vessel in distress, he must immediately inform the master of the vessel in distress accordingly. Moreover, he must enter in his log-book the reasons justifying his action.

The above provisions do not prejudice the International Convention for the unification of certain rules with respect to Assistance and Salvage at Sea, signed at Brussels on the 23rd September, 1910, and, in particular, the obligation to render assistance laid down in Article II. of that Convention.

ARTICLE 38.—The High Contracting Parties undertake to take all steps necessary for giving effect to the provisions of this chapter with the least possible delay. Nevertheless, they may allow :

A delay not exceeding one year, from the date of the ratification of this Convention, for the provision and training of operators and for the installation of the apparatus on ships placed in the First and Second Classes.

A delay not exceeding two years, from the date of the ratification of this Convention, for the provision and training of the operators and watchers on the ships in the Third Class, for the installation of the apparatus on ships in the Third Class, and for the establishment of a continuous watch on ships placed in the Second and Third Classes.

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Wireless Telegraphy in the Italian African Colonies

By Lieut. G. MONTEFINALE, of the Royal Italian Navy

[*A graphic account of the development of Italian Somaliland and of the part wireless telegraphy has played therein. The whole of the apparatus for the extensive system established there was supplied to the Italian Government by the Rome Agency of Marconi's Wireless Telegraph Company of London. Messrs. Micchiardi and Ricciardelli, of the Italian Navy, under whose supervision the stations were erected, received the privilege of a course of study in the Marconi high-power stations in Europe.*]

WIRELESS telegraphy, from the very first, has proved to be of invaluable assistance to travellers, both on land and sea. More especially is this the case with those who have penetrated the wild regions of the African continent, where bold pioneers have succeeded in establishing the authority of practically all the most important European nations.

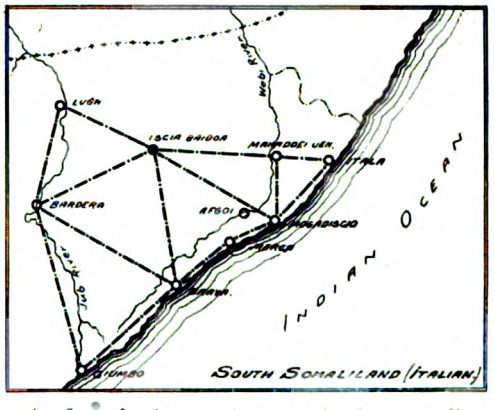
In these lands, where there were no roads, no railways, no telegraphs or any other means of distance communication the introduction of Marconi's wireless telegraphy has marked a new era of civilisation, and has played an important part in the pacification of large tracts of land which were found very difficult to control by the Governments and troops in possession of them.

The colony which affords the best example of such wireless control is perhaps the Italian Somaliland in Eastern Africa.

As is well known, it was in 1889 that Italy took up the protectorate of Northern Somaliland, from the shore of the Aden Gulf down to Warsceik on the Indian Ocean coast, under the name of Benadir. Afterwards the sphere of the protectorate was extended to take in the whole of Southern Somaliland down to Kismayu, which is the extreme northern boundary of the province of Juba in the British East Africa Protectorate.

Benadir was formerly under the control of the Sultan of Zanzibar, from whom Italy obtained the regular possession of it.

To make the occupation of Benadir of lasting effect was a task of great difficulty, and was carried out on these lines. The principal points on the sea coasts were taken possession of by the warships of the Italian Royal Navy. The enterprise was made the more difficult owing to the fanatical



attitude of the natives and the peculiar conditions of the shores, which are visited for several months in the year by the two monsoons of the Indian Ocean.

As may be imagined, these circumstances rendered communication between the points occupied on the coast—Itala, Mogadiscio, Merca, Brava, Giumbo—very uncertain, and militated largely against concerted movements of the troops stationed at one station with those of another, and this was especially the case with regard to the two farthest inland points, Bardera and Lugh. The latter station is some 300 km. from the coast. Furthermore, these great distances separating the various garrisons could only be traversed by means of caravan roads, which are at no

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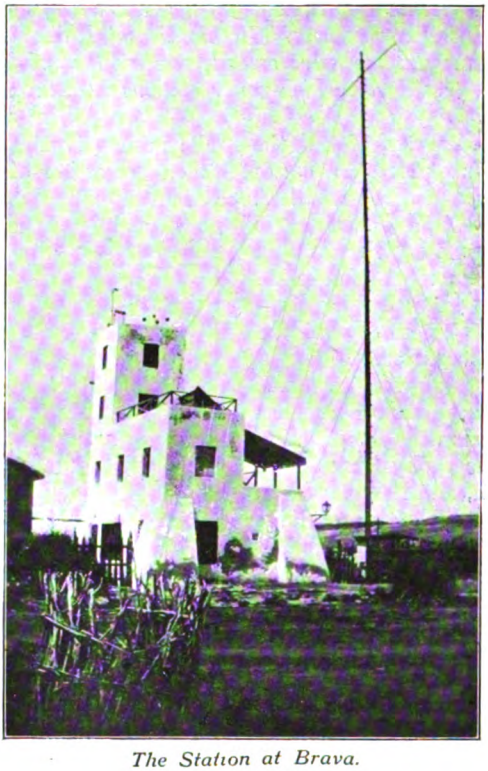
time safe for the unpractised traveller, but which were rendered still more insecure by reason of the hostile attitude of the natives who frequented them, so that it is not surprising to learn that up to 1908 the total extent of the Italian rule in these parts was limited to the strip of sea-coast and to certain areas on the left bank of the river Giubba.

Often the Italian Governors and officials were murdered, and always the news of such disasters reached the seat of the Government too late to make relief expeditions or even punitive campaigns at all practicable. Many districts were so isolated from Mogadiscio that for many years bands of Somaliland dervishes or Abyssinian robbers were accustomed to beset and besiege them regularly, without any fear of reprisals.

Furthermore, during those long years of hampered government no regular forward movement of the troops was possible in the fertile region of the river Uebi Scebeli, which runs for a very long tract of the inner Somaliland, owing both to lack of roads and any possibility of long distance communication.



The Station at Brava.

It was in 1908 that the Italian Government, after witnessing the magnificent results obtained by the Marconi system of wireless telegraphy both in Europe and across the Atlantic, decided to erect in the most important centres of Southern Somaliland a complete network of wireless telegraph stations.

The scheme contemplated three stations of medium range (3 kw.) and four of short range. The sites chosen were: Itala, Mogadiscio, Merca, Brava, Giumbo on the coast and Bardera, Lugh, inland.

The shipment of the material, which was not an easy task, had to be carefully thought out, but finally a vessel of the Italian Royal Navy carried the material and the staff of engineers and mechanics to the scene of their forthcoming triumph.

On arrival, many further difficulties were encountered during the disembarkation of the material for the construction of the buildings, and subsequently the whole of its transportation to the inland stations had to be effected on camel-back, across the intricate paths of the thick Somaliland woods. In spite of what often seemed to be insurmountable difficulties, the stubbornness and energy of the Lieutenant of the Royal Italian Navy, Mr. Micchiardi, who was charged to carry out this gigantic task, achieved the desired result and in less than a year the whole of the Somaliland network had been completed, and connection had been established between the various points of the colony occupied by the Italian flag.

Most important changes followed in the political and economic situation, and they were all of them entirely due to this very powerful means of communication, for by it the control of the Italian Colonial Government was immediately extended all over the area occupied, and very soon those responsible for the Government of the country were rejoiced to discern signs of the complete pacification and submission of the rebellious tribes. Meanwhile the natives themselves, especially the Indian, Arabian and Somalian merchants, of the places where Marconi wireless stations had been installed, soon became accustomed to the innovation, and after their first bewilderment was overcome they did not fail

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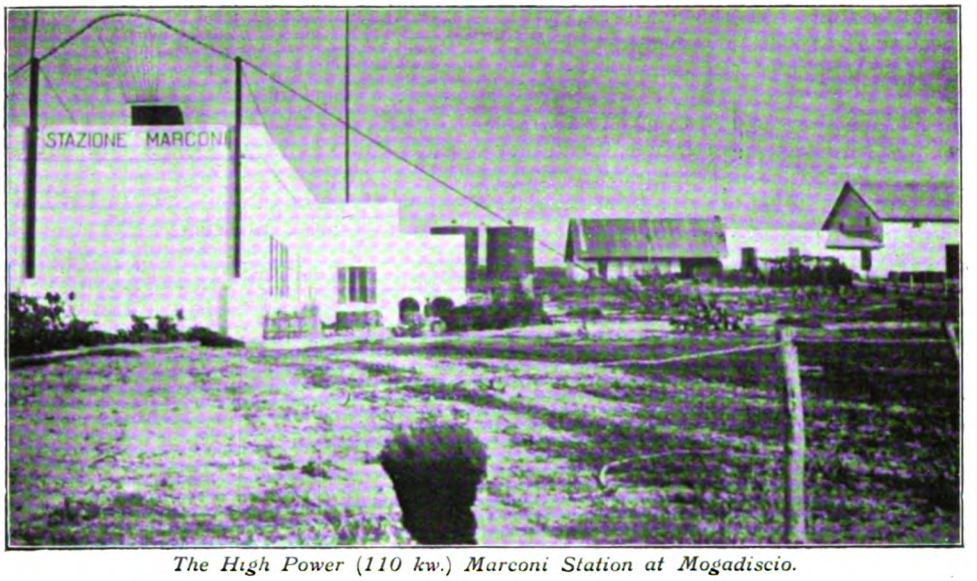
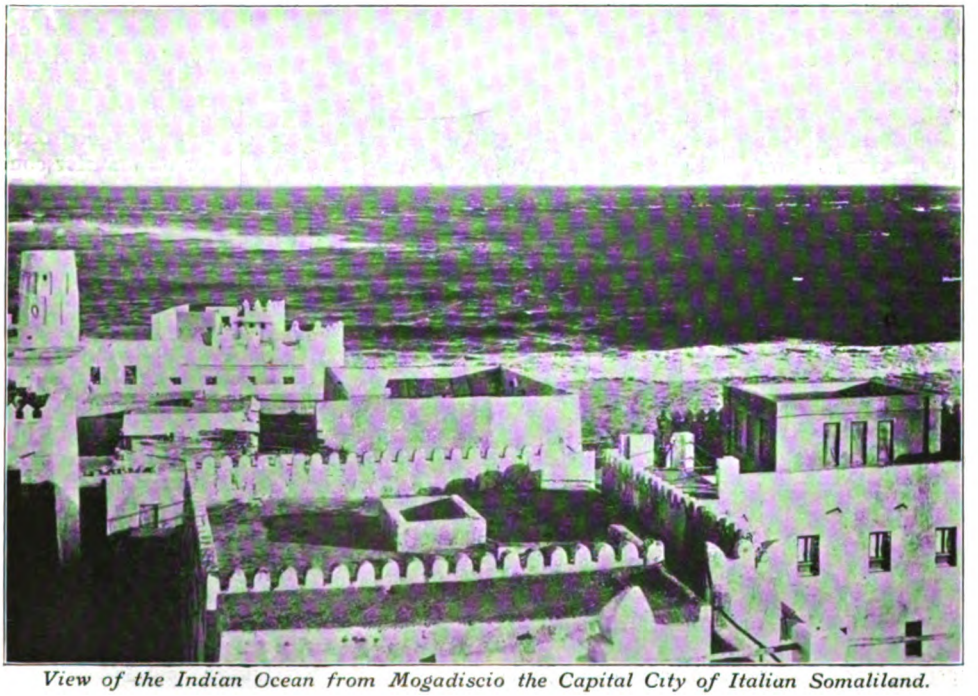


The High Power (110 kw.) Marconi Station at Mogadiscio.

to take advantage of the new telegraph system, recognising the superiority of this means of exploiting their inland trades and even for the swifter settlement of their private affairs.

Its successful installation made it possible for the Italian troops to effect a progress to the interior regions, crossed by the river Uebi Scebeli. This had been attempted before by a handful of intrepid officers of the Italian Navy, but they had been cruelly slaughtered at Lafolé. The new expedition was equipped with field stations, whereby



View of the Indian Ocean from Mogadiscio the Capital City of Italian Somaliland.

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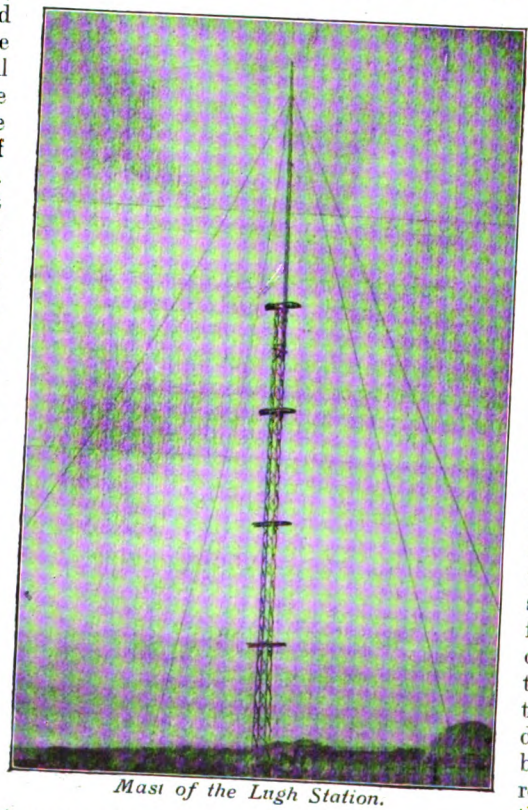
communication with the fixed station at Mogadiscio was constantly maintained. After the main object was accomplished, these field stations were definitely installed at certain points on the mysterious river where Italian garrisons had been stationed; and they are still in existence in those places, where, in spite of the old type of the stations and their constant use, they continue to afford a very good service.

This, however, was not enough. The Italian colony of Benadir, although almost completely pacified, was not yet connected in any way with the Mother Country. All telegrams had to be sent by sea to the telegraph offices of Mombasa and Aden. If we consider that the maritime communications at that time were limited only to the north-east monsoon season, during which it is possible to establish the traffic with the land (which is altogether interrupted during the season of the south-west monsoon), it is easy to understand how often very important news would reach the central Government n Rome many weeks, even months, after date.



Mast of the Lugh Station.

It was therefore decided to erect two high power Marconi stations, one at Massawa and the other at Mogadiscio. In this way, telegrams originating from the Italian Somaliland offices could be sent, through the Massawa station and the wire telegraphs of Egypt and the Sudan, to Italy.

This time the Italian Royal Navy, in consequence of the experience acquired in the preceding installation of colonial wireless telegraph stations, were able to install the two new 110 kw. stations within a very short space of time. It should be pointed out, however, that although it is comparatively easy to erect stations of such a power in civilised countries where there are all the necessary means, it is a totally different thing to do so in the African colonies, where the conditions of life are extremely primitive and organisation far from perfect.

The Massawa station was erected in less than a year, the success of the work being due to the energy of Mr. Micchiardi, Lieutenant of the Italian Royal Navy. The signals of this station were received very clearly also in Italy.

The erection of the Mogadiscio station was more difficult, as it is situated on the dunes formed by the effect of the two monsoons on this desolate coast. The landing of the larger material, whereof some of the pieces weighed as much as five tons, was accomplished by astonishingly primitive means, and it is due entirely to the wonderful enthusiasm and ability of the Italian marines that everything was put on shore in good order, for its transfer could only be effected by the difficult negotiation of many very dangerous passages between the coral reefs, which rise through the surf, that continually dashes in white foam against their rough escarpments. The installation of this station was under the direction of Lieutenant Ricciardelli, who had among his more obvious duties to supervise and direct the blasting of a stone quarry, the digging of wells for the water necessary for the works, and the construction of the buildings, machinery and apparatus.

In November, 1911, the labour of the Mogadiscio station construction was brought to an end, and the two Italian colonies of Eritrea on

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the Red Sea and of the Italian Somaliland on the Indian Ocean were brought into communication over a distance of more than 1,600 km., across large tracts of dry lands, and over the mountainous range of the Abyssinian high plateau, which at times reaches to the height of 2,500 metres.

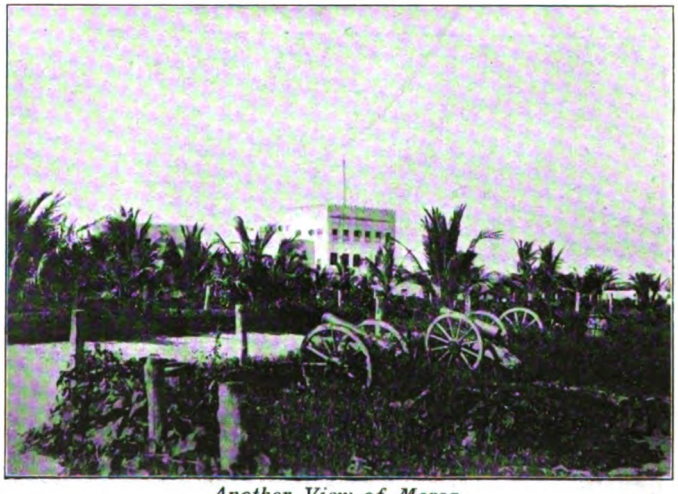
Notwithstanding the very intense atmospheric discharges of the tropical regions, the service of the two stations is carried on with the greatest regularity. The signals are received with a valve detector, and these are so strong that the human ear of moderate power may detect them.

In general, the two stations have each a 110 kw. generating plant, composed of a 2,000 volts monophase alternator, with 29 periods, designed to supply the electric current necessary to operate the station. Each of the two stations is driven by a Diesel type oil motor of 150 h.p. Such a type of motor has proved to be very practical for use in places like Massawa and Mogadiscio, where coal is charged at a very high price. Five twenty-five kw. transformers transform the 2,000 volts current into a 1,500 volts current, which serves to feed a battery of 74 condenser groups of the Poldhu type, connected in series of groups of three. The rotating disc of the Marconi system is run at a velocity of 3,000 revs. per minute by means of a special electric motor, and the spark gives a distinct musical tone.

The aerial of each of the two stations is formed by thirty parallel horizontal wires, supported and directed according to the connecting line of the two stations, by means of eight large iron towers, each 75 metres in height.

View of the Uebi Scebeli River.

Besides the Italian authorities and the citizens of the colonies, the British Authorities of Jubaland use the high power stations of the Italian colonies in Equatorial Africa for purposes of communication with the office of the "British East Africa Protectorate" in Nairobi, while the merchants of the Benadir coast take advantage of it to send messages to Aden, Bombay, Mombasa, Zanzibar, etc.



Another View of Merca.

Furthermore, the numerous ships of the ss. lines which follow the route of Aden, Mombasa, Zanzibar, Dar-es-Salaam, find in the wireless telegraph stations on the Italian

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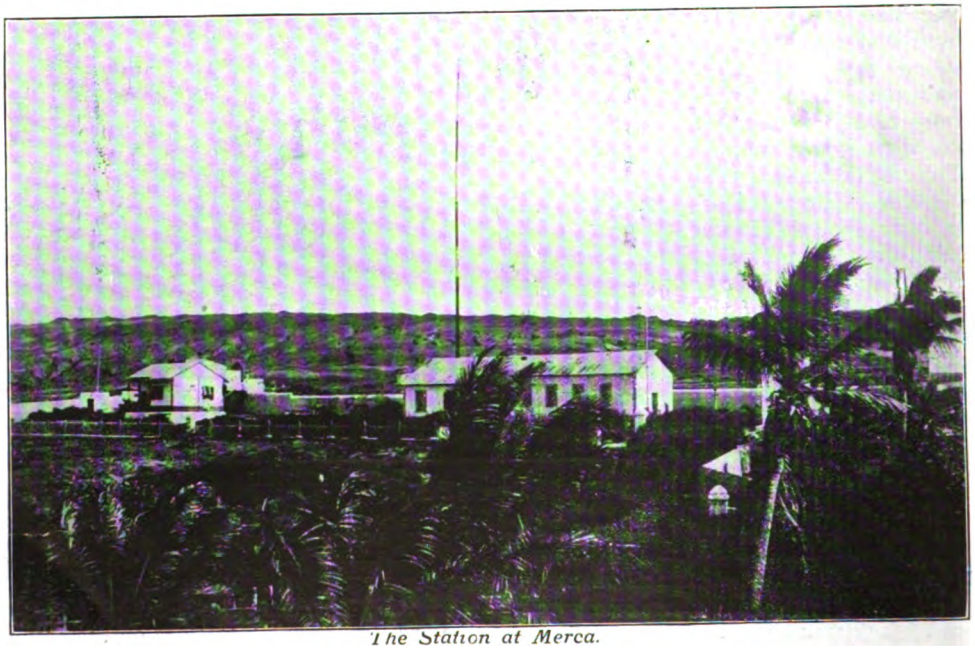
coast of Benadir very convenient points for the transmission of telegrams directed to Europe and other parts of the world.

During 1913, the occupation of the Italian Government was extended to all the territory which was awarded them by the Italian-Ethiopic Convention for the delimitation of the frontiers stipulated in 1908. For that purpo se new garrisons were established in the region of Mahaddei-Uen, in the higher reaches of the Uebi Scebeli River, and at Iscia Baidoa, on the Abyssinian borders.

In these two places permanent stations of $\frac{1}{5}$ kw. and $1\frac{1}{2}$ kw. respectively were constructed. The installation at Iscia Baidoa, erected on the same plan as the others by the Italian Royal Navy, attracted especial attention, because its installation was commenced within only a few days after the occupation of the country, and this in spite of many and great hardships sustained by the staff both on account of the difficulties of transport and also of the rough living conditions, for all the regular routine to which sailors are accustomed was found to be impossible of continuance, and hardly the necessities of every-day existence could be procured, much less any of the comforts of civilisation.

But present results have amply repaid all the labours and trials of installation, for now the wireless telegraph service in the Italian Somaliland proceeds with a regularity which it seems does not exist among the networks of the regular wire telegraphs. Besides, the erection of telegraphic lines in these regions would have been absolutely impossible, especially during the first years of the occupation, for an apparently illimitable plain stretches itself out of sight from the downs of the Benadir to the foot of the Abyssinian mountains of Harrar and of Arussi, and this plain is entirely covered by a thick network of scrub and undergrowth, which is almost impenetrable, only broken here and there by narrow and intricate paths, made by the thousands of wild animals, not excluding the elephant, which make their homes in these wild regions, while the natives of these parts, no matter how friendly disposed they may be to the new order of things, are much too ignorant and superstitious to be of any use in the task of keeping such an extensive system of lines as would be required by the ordinary telegraph in proper repair. But chiefest of all there is the insurmountable problem of making the telegraph poles impervious to the attacks of termites or white ants, which encompass the destruction of anything in the shape of dried wood.



The Station at Merca.

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The Production of Vibrations on Strings.

By Professor J. A. FLEMING, M.A., D.Sc., F.R.S.

[*Professor Fleming exhibited at a recent meeting of the Physical Society of London an apparatus for the production of vibrations on strings, loaded or unloaded. This is described in the paper which we reprint here from the Proceedings of the Society.*]

THE problem of determining the possible vibrations of a loaded string—that is, a flexible string having small masses attached to it at equal distances—is one to which many mathematicians have given attention. It suffices to mention the well-known discussion of the problem by Lagrange,* the full treatment of it by Lord Rayleigh,† and an interesting Paper by Mr. C. Godfrey ‡ published in 1898.

Of late years the matter has acquired an electrical interest from the close analogy existing between the transmission of mechanical vibrations along a loaded string and the propagation of alternating electric currents along a telephone cable having inductance coils inserted in it at equidistant intervals. In seeking for experimental methods of illustrating the properties of such loaded cables it was natural to turn for assistance to the visible oscillations produced on strings loaded or unloaded.

Almost the only method hitherto used for creating sustained vibrations on strings has been the elegant device of F. E. Melde, in which a string attached to the prong of a tuning fork is set into stationary sympathetic vibrations when the length and tension of the string is adjusted so that the vibrations travel along it in a time which has some integer ratio to the periodic time of the fork.

The objections to this method are (1) that we cannot put more than a certain tension on the string without stopping the fork even if the latter is electrically driven, (2) that when long loaded strings are employed we need very large forks to provide a sufficiently low frequency in the impulses, (3) that we cannot alter the frequency of vibration except by changing the fork, (4) that the vibrations of the string take place only in one plane and are not very visible unless viewed from a certain standpoint.

In thinking over these difficulties it occurred to me that the fork could with great advantage be replaced by a small continuous-current electric motor, the speed

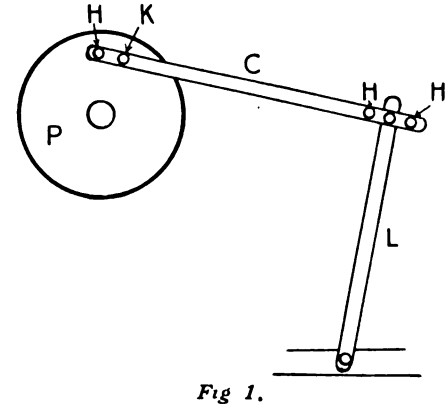

Fig 1.

of which can be easily controlled and measured and made low or high enough to study the vibrations on a string of any length, loaded or not loaded, and with any reasonable applied tension.

The best arrangements were found to be as follows :—

On the shaft of a small continuous-current motor, say, ⅛ H.P. or ¼ H.P., is attached a pulley or disc which has a crank pin (K) inserted on its outer face at a distance

* *Mecanique Analytique*, Vol. I., part 2, sec. VI., § III.
† *Theory of Sound*, Vol. I., Chap. VI., 2nd edition.
‡ "On Discontinuities Connected with the Propagation of Wave Motion along a Periodically Loaded String." *Phil. Mag.*, April, 1898, p. 356.

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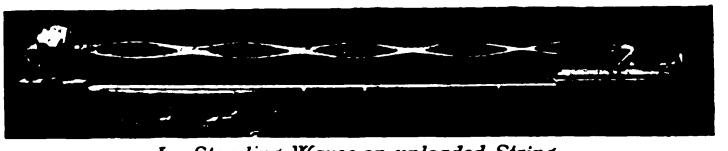
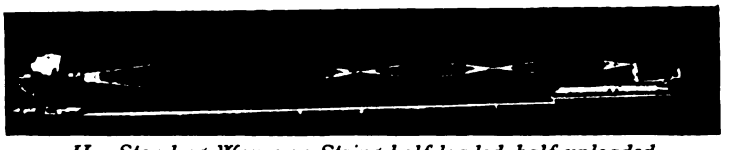
of about 0·5 in. from the centre (*see* Fig. 1). To this pin is attached a light crank shaft (C) which is connected at the other end to a rocking lever (L). A small hook (H) is attached to the crank shaft, quite close to the crank pin, and another at the far end, close to the junction with the top end of the rocking lever.

On the other end of the motor shaft is an endless screw gearing with a toothed wheel, the latter carrying a pin on its face which strikes once in every revolution against a small piece of steel clock-spring. This mechanism serves to count the speed of the motor, as we can take the time of 20 or 1,000 revolutions of the wheel by a stop-watch and, knowing the gear ratio, obtain the speed of the motor. The hook on the crank shaft near the crank pin describes, therefore, a circular path in space without rotation, and the hook at the far end of the crank shaft moves to and fro with an approximately simple harmonic motion.

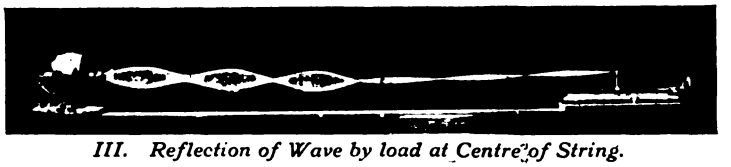
If, then, we fasten a long stretched flexible cord to either hook we have the means of impressing upon the end of the cord simple harmonic motions either (1) in the direction of its length, or (2) transverse to its length, or (3) a circular motion equivalent to the combination of two simple harmonic motions differing 90 deg. in phase, each taking place in a direction at right angles to the direction of the stretched cord.*



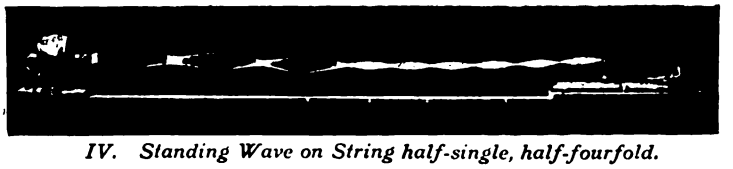
I. Standing Waves on unloaded String.



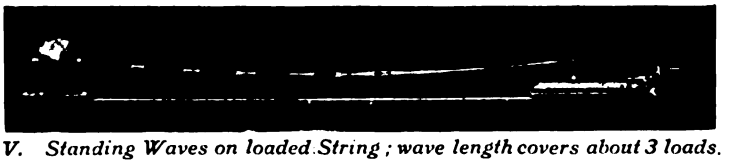
II. Standing Waves on String half-loaded, half-unloaded.



III. Reflection of Wave by load at Centre of String.



IV. Standing Wave on String half-single, half-fourfold.



V. Standing Waves on loaded String; wave length covers about 3 loads.

Fig. 2.

The remote end of the cord is attached to a pin which is screwed into a nut travelling on a long screw similar to the slide rest of a lathe (*see* Fig. 2). We can by this means put any desired tension on the cord, and also measure the tension by a spring balance inserted between the end of the cord and the terminal pin. If, then, we attach one end of the cord to the hook nearest the crank pin of the motor with the string stretched parallel to the axis of the motor and apply a certain tension at the other end of the string, and set the motor in rotation,

* Since this Paper was printed my attention has been drawn to a footnote in Tyndall's *Lectures on Sound*, Lecture III., p. 96, where he describes a lecture experiment in which a catgut cord had one end whirled round by hand by being attached to a whirling table, the other end of the cord being fixed. The result was to produce stationary vibrations on the cord. The uniformity of rotation must in such case depend on the skill of the operator, and cannot be comparable with that produced by an electric motor. Tyndall does not appear to have used this apparatus for quantitative experiments, nor for experiments on loaded strings as described by me, but he placed beads on his cord for the purpose of showing that such part of the cord was moving in a circle.

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we shall have vibrations propagated along the cord so that each part of the cord describes a circular motion. By properly adjusting the tension and the speed of the motor stationary oscillations may be set up on the cord which are the resultant of two simple transverse harmonic motions at right angles and differing 90 deg. in phase. The cord, therefore, when vibrating appears spindle shaped in virtue of the persistence of vision, and if the tension is adjusted we can make the cord vibrate in a single loop or in 1, 2, 3, &c., loops up to a dozen or more segments corresponding to the various harmonics of the fundamental mode of vibration of the cord (*see* Fig. 2).

By the slide-rest arrangement the tension can be accurately adjusted so as to produce any required number of sections and keep them steady. By sending the beam from an arc-lamp lantern along the cord these stationary vibrations can be rendered visible to large audiences. We can easily measure the half wave-length or distance from node to node by a beam compass, and having also the means of measuring the speed of the motor we can calculate the velocity with which a wave motion of any wave-length producible travels along the cord.

Arrangements can also easily be made to apply a tension to the cord by means of a weight attached to the end in the usual manner by passing the end of the cord over a fixed pulley.

The cord can be loaded by fixing on it at equal intervals glass beads or cork or wooden balls, and the possible modes of vibration on this loaded cord studied. By loading half of the cord or a middle portion, we can examine the reflection effects taking place when a vibration passes from one medium to another of different mean density. The following is the simple analytical treatment of the problem.

Let us assume that the mass of each load on the cord is m, in which we must include the mass of the length of cord intervening between two loads. Let d be the distance between the masses. Suppose also that in any shape into which the cord is thrown in its vibrations the angle made by any section of the cord with the straight line joining the extremities of the cord is so small that we may take the sine of this angle as equal to its tangent. Also let T be the tension of the cord, and let y_n be the transverse displacement of the nth mass. Then, following a method used by Prof. Tait,* we have for the equation of motion of that mass

$$m\frac{d^2y}{dt^2} = \mathrm{T}\left(\frac{y_{n+1}-y}{d}\right) - \mathrm{T}\left(\frac{y_n-y_{n-1}}{d}\right). \quad (1)$$

which expresses the fact that the difference of the components of the tensions taken perpendicular to the undisturbed cord on either side of any mass is the moving force on it. If we put $y_n = \mathrm{Y}\cos(pt-qx)$, where $p=2\pi/\tau$ and $q=2\pi/\lambda$, τ and λ being the periodic time and wave-length of the motion respectively, then on substitution in (1) we have

$$-mp^2\cos(pt-qx) = \frac{\mathrm{T}}{d}\{\cos(pt-q(x+d)) - 2\cos(pt-qx) + \cos(pt-q(x-d))\} \quad (2)$$

or

$$p^2 = \frac{4\mathrm{T}}{md}\sin^2\tfrac{1}{2}qd \quad (3)$$

Writing n for $p/2\pi$ and V for $n\lambda$ we have

$$\mathrm{V} = n\lambda = \sqrt{\frac{\mathrm{T}}{m/d}}\cdot\frac{\sin \pi d/\lambda}{\pi d/\lambda} \quad (4)$$

The above is a correct analysis if the vibrations are in one plane, but as regards the case under consideration, viz., when each portion of the string is moving in a circle having its plane perpendicular to the line of the undisturbed cord, we must arrive at the equation of motion in another way.

Since each load then describes a circle of constant radius y, the centrifugal force on a mass m moving with angular velocity p is mp^2y; and if we consider the load at y it is $mp^2y\cos(pt-qx)$. This force, however, is balanced by the sum or difference of the resolved parts of the tensions on either side of it, taken perpendicular to the axis of revolution. Hence we have

$$mp^2y_n = \mathrm{T}\left(\frac{y_n-y_{n-1}}{d}\right) - \mathrm{T}\left(\frac{y_{n+1}-y_n}{d}\right)$$

and by substitution for y_n of $\mathrm{Y}\cos(pt-qx)$ gives us the same equation (2) and hence (4) follows, as above.

If d/λ is very small, that is, if the loads are very close together, then $m/d=p$ is the average density per unit of length, and the formula reduces to $\mathrm{V}_0 = \sqrt{\mathrm{T}/\rho}$, which is the known expression for the velocity of propaga-

* *See* article "Wave." *Encyclopædia Britannica*, 9th edition.

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tion of a wave along a cord of mass per unit length p and longitudinal tension T. Hence, if we call this latter the wave velocity corresponding to the uniformly distributed or smoothed out masses we have finally

$$V = V_0 \frac{\sin \pi d/\lambda}{\pi d/\lambda}. \qquad (5)$$

Also (5) can be written

$$n = \frac{1}{\pi d}\sqrt{\frac{T}{m/d}} \sin \pi d/\lambda \qquad (6)$$

From which it is seen that no frequency greater than $\sqrt{T}/\sqrt{\pi^2 md}$ can be propagated along the loaded cord. This corresponds to about three loads per wave, or when $d = \lambda/2$.

The values of $(\sin \pi d/\lambda)/(\pi d/\lambda)$ in terms of λ/d or the number of loads per wave are given in the Table I. below :—

TABLE I.

λ/d	$(\text{Sin } \pi d/\lambda)/(\pi d/\lambda)$	λ/d	$(\text{Sin } \pi d/\lambda)/(\pi d/\lambda)$
1	0	6	0·955
2	0·637	7	0·967
3	0·827	8	0·974
4	0·900	9	0·980
5	0·935	10	0·984

It is obvious that this ratio runs rapidly up towards unity and that even when λ/d is as small as 10 the discontinuous loading is equivalent in practical effect to continuous loading, as if the added mass was uniformly distributed along the string.

These deductions from theory can be easily illustrated and confirmed by the use of the vibrating string apparatus above described.

The best cord to use with it is a light inelastic cord called cotton cord, and a useful diameter is about 1*mm.* or 2*mm.* The sample I have used has a weight of 0·00839 gramme per centimetre.

A length of 2 or 4 metres was employed and one end attached to the motor, the other being led over a light aluminium pulley well pivoted and terminated in a scale pan in which weights were placed. Using appropriate tensions and frequencies the cord was thrown into stationary vibrations giving 1, 2, 3, 4, &c., half-wave lengths or loops. The frequency N (per second) and wave-length λ were measured and also the tension T of the cord in grammes weight, reduced to dynes by multiplication by 981.

The product $N\lambda$ was then compared with the quotient $\sqrt{T}/\sqrt{\rho}$, where $\rho = 0{\cdot}00839$. The following Table II. gives the results :—

TABLE II.—*Transverse Vibrations of an Unloaded String.*

ρ = weight per cm. = 0·00839 gramme. Length = 2 metres

No. of half-waves or loops.	Tension of string = T. Grms	Tension of string = T. Dynes.	Frequency of oscillations per sec. = N.	Wave-length in cms. = λ.	Velocity of propagation. $N\lambda$	Velocity of propagation. $\sqrt{T}/\sqrt{\rho}$
1	1,000	981,000	27·9	390	10,909	10,850
2	335	329,000	31·8	200	6,360	6,280
3	150	147,000	32·9	130	4,280	4,206
4	87	85,400	32·9	98	3,220	3,220
5	50	49,100	30·7	79	2,320	2,420
With a cord 4 metres in length vibrations up to the 10th harmonic could be obtained, giving from 10 to 19 loops or half-waves.						
10	55	54,000	31·2	80	2,496	2,540
19	15	14,710	32·2	40	1,288	1,320

It will be seen that the wave velocity given by product $N\lambda$ is approximately equal to the quotient $\sqrt{T}/\sqrt{\rho}$. There is a certain difficulty in measuring the wave-length as the nodes are not very sharply defined, but the agreement is fairly good and proves that the velocity of propagation of the wave varies as the square root of the tension and inversely as the square root of the density of the cord.

A second set of measurements was made employing a constant tension of 110 grammes on the cord and variable speeds of the motor to produce different wave-lengths, and the results are embodied in Table III. :—

TABLE III.—*Transverse Vibrations of an Unloaded String.*

ρ = weight per cm. = 0·00839 gramme. Length = 2 metres.

No. of half-waves or loops.	Tension of string = T. Grms	Tension of string = T. Dynes.	Frequency of oscillations per sec. = N.	Wave-length in cms. = λ	Velocity of propagation. $N\lambda$	Velocity of propagation. $\sqrt{T}/\sqrt{\rho}$
1	110	108,000	8·5	390	3,310	3,580
2	110	108,000	17·8	201	3,580	3,580
3	110	108,000	26·1	134	3,500	3,580
4	110	108,000	36·1	98	3,540	3,580
Length of cord 4 metres.						
2	110	108,000	8·7	404	3,520	3,580
4	110	108,000	17·8	201	3,580	3,580
6	110	108,000	26·9	134	3,600	3,580
8	110	108,000	36·7	98	3,600	3,580

These last results similarly prove that within the limits of wave-length employed the velocity of propagation is independent

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of the frequency and equal to the quotient $\sqrt{T}/\sqrt{\rho}$.

On the cord 4 metres in length there was no difficulty in producing as many as 20 half-waves quite stationary, each having a length of 20 cm.

The next step was to prepare a loaded cord by placing on the same cotton cord glass beads each weighing 0·208 gramme at distances of 20 cm. The mean density or weight per centimetre length of cord was thereby raised to 0·0188 gramme. The same experiments were then repeated with this loaded cord using variable tensions (Table IV.), and constant tension (Table V.) with the results given.

TABLE IV.—*Transverse Vibrations of a Loaded String.* Loads of 0·208 gramme at intervals of 20 cm. Mean weight per cm. = ρ = 0·0188 gramme. Length of cord = 4 metres. Variable tension.

No. of half-waves or loops.	Tension of string = T.		Frequency of oscillations per sec. = N.	Wave-length in cms. = λ	Velocity of propagation.	
	Grms	Dynes.			$N\lambda$	$\sqrt{T}/\sqrt{\rho}$
3	810	795,000	25·0	266	6,650	6,510
4	550	540,000	26·8	200	5,360	5,360
5	380	373,000	28·0	158	4,420	4,460
6	265	260,000	29·1	130	3,790	3,720
7	205	201,000	29·1	110	3,210	3,280
8	180	177,000	31·2	97	3,020	3,060

TABLE V.
Same loaded string as in Table IV., but with constant tension.

No. of half-waves or loops.	Tension of string = T.		Frequency of oscillations per sec. = N.	Wave-length in cms. = λ	Velocity of propagation.	
	Grms	Dynes			$N\lambda$	$\sqrt{T}/\sqrt{\rho}$
2	210	206,000	8·1	400	3,240	3,310
3	210	206,000	12·8	266	3,400	3,310
4	210	206,000	16·6	200	3,320	3,310
5	210	206,000	19·9	160	3,200	3,310
6	210	206,000	24·6	132	3,240	3,310
7	210	206,000	28·6	110	3,160	3,310

It will be seen that here also the wave velocity measured by the product $N\lambda$ is approximately equal to the quotient $\sqrt{T}/\sqrt{\rho}$ and that the wave velocity is independent of the frequency.

The loaded cord, however, differs from the unloaded in this respect, that whereas there was no difficulty in producing on the unloaded string as many as 19 or 20 stationary half-waves or loops, each about 20 cm. in length, it was found quite impossible to produce waves as short as this on the loaded string with loads 20 cm. apart. The latter refuses to oscillate sufficiently quickly and will not propagate waves of a higher frequency than corresponds to a wave-length of rather more than double the distance between the loads. On putting on a higher frequency at one end of the cord the vibrations or loops on it are seen to die away quickly, but sustained stationary oscillations on the whole length of the loaded string cannot be set up unless the frequency is less than the critical value.

This method of exciting the oscillations on a string can also be employed to exhibit in a beautiful manner the wave reflection that takes place at the junction between two strings of equal tension but unequal mass per unit of length or at the junction between an unloaded and a loaded string.

If we place glass beads at regular intervals on one-half of a string 4 metres long and attach the extremity of the unloaded half to the motor wheel and apply a tension at the remote end, then standing waves will be produced on both parts when the tension is adjusted (*see* II., Fig. 2). These standing waves have, however, different wave-lengths on the two parts which are inversely as the square roots of the mean cord densities. Thus in one experiment tried the standing waves had a wave-length of 100 cm. on the unloaded half of the string and a wave-length of 66 cm. on the loaded half. These two parts of the string had mean densities of 0·00839 and 0·0188 gramme per centimetre respectively. The ratio of the square roots of these last numbers is as 29 is to 43·3 and $29 \times 100 = 2{,}900$ whilst $43{\cdot}3 \times 66 = 2{,}858$. Hence the wave-lengths are nearly inversely as the square roots of the mean cord densities. The amplitude of the waves on the unloaded half of the cord was, however, much greater than that of the waves on the loaded cord, thus showing the loss of amplitude on reflection. The same thing can be better shown by employing a cord one half of which is single and the other half made of four similar cords in parallel and tied together at intervals. When this is vibrating we have waves on the four-fold part which are half the wave length of those on the single part (*see* IV., Fig. 2).

Again, if the tension was decreased slightly so as to lower the velocity and decrease the length of the waves a point was soon reached

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at which, whilst standing waves were produced on the unloaded half of the cord, no waves were produced on the loaded half. This happened when the length of the waves on the unloaded half was about 60 cm. and therefore those on the unloaded half should have been about 40 cm., or equal in length to twice the distance between the loads; so that one wave would cover three loads or a little more.

This experiment proves clearly that there is an inferior limit to the possible wavelength and a superior limit to the possible frequency of the vibrations which can be produced on the loaded string exactly as predicted by theory. The same reflection of the waves and loss of amplitude on passing a junction between two uniform cords of different mass per unit of length can be shown by joining two cords of equal length, one a plain cotton cord and the other a piece of whipcord or heavy gilt thread, and attaching one end of the length to the crank of the motor and applying a tension to the other end. By adjusting this tension it is easy to show the loss in amplitude of the wave in passing such a junction, or even the total reflection of the wave (*see* III., Fig. 2). This phenomenon has its electrical analogue in the loss in amplitude or reflection of the electrical waves at the junction between two conductors, say, an unloaded land line and a submarine cable, or loaded line, the two having different capacities and inductances per mile when telephonic currents are transmitted through such a circuit.

Again, we can show by this vibration apparatus the advantage of tapering off the loading in the case of a junction between a loaded and an unloaded line owing to the diminution of the reflection losses. When a wave passes from one medium to another of different refractive index, and if this index changes somewhat suddenly at the junction plane we know that wave reflection takes place. If, however, the index changes gradually the reflection losses are much reduced or else annulled. Hence, if a loaded telephone cable is connected to an unloaded cable partial reflection of the wave takes place at the junction. If, however, the loading is tapered off, these reflection losses are much reduced. This can be visibly illustrated by the vibrating string apparatus very easily. If we load one-half of a string with glass beads but taper off the loading by using towards the middle point beads or knots of gradually decreasing mass, and then attach one end of the unloaded half to the motor crank and apply a tension to the other end of the whole cord, we shall see that the reflection losses at the junction are much reduced.

The partial reflection and consequent loss of amplitude in the transmitted wave can even be shown by placing a single bead or load of appropriate mass in the centre of an otherwise unloaded string. If one end of the string is vibrated and a suitable tension applied we can produce stationary waves of large amplitude on that part of the string between the motor and the load, but the amplitude of the vibrations produced on the far side of the load is much less, thus showing the partial loss of amplitude in the transmitted vibration owing to the reflection losses.

In conclusion, a short method may be given for arriving at an expression for the velocity of propagation of an electric wave along a coil-loaded telephone cable, which was first given by Prof. I. Pupin in his important memoirs on this subject,* but which may be obtained more simply in the following manner :—

Let us assume we have a two-wire cable having capacity C and leakance S due to the dielectric between the wires, both reckoned per unit length of the circuit. Let us suppose that loading coils, each having inductance L_1 and resistance R_1, are inserted at intervals d along the cable. Also let the cable itself have a conductor resistance r and inductance l per unit of length. Let us denote the currents through three successive loading coils by i_{n-1}, i_n and i_{n+1}, and the P.D. between the wires by v_1 at a point half-way between the $(n-1)$th and nth coil, and by v_2 half-way between the nth and $(n+1)$th coil. Furthermore, let the currents and potentials be simple harmonic functions of the time and vary as the real part of e^{pt}, where $j=\sqrt{-1}$ and $p=2\pi$ times the frequency. Hence $d/dt=jp$ and $d^2/dt^2=-p^2$.

Consider, then, the section of the cable

* *See* I. Pupin, *Transactions of the American Institute of Electrical Engineers*, Vol. XVI., p. 93, 1899, and Vol. XVII., p. 445, 1900. Also *see* J. A. Fleming, *The Propagation of Electric Currents in Telephone and Telegraph Conductors*, 2nd edition, p. 110.

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between the $(n-1)$th and nth loading coil. The average gradient of the current in that section of the cable is $(i_{n-1}-i_n)/d$, and if this gradient line is nearly straight the gradients must be equal to $(S+jpC)v_1$.

Also in the same manner for the next section we shall have $(i_n-i_{n+1})/d$ equal to $(S+jpC)v_2$.

Therefore, taking the difference we have

$$\frac{(i_{n-1}-i_n)-(i_n-i_{n+1})}{d}=(S+jpC)(v_1-v_2). \quad (7)$$

But if the impedance of each coil is large compared with that of the line between the coils, we can say that,

$$v_1-v_2=(R_1+jpL_1)i_n \quad (8)$$

If, however, we include the resistance r and inductance l of the cable itself apart from those of the loading coil we must write this last equation in the form

$$v_1-v_2=i_n\left\{\left(r+\frac{R_1}{d}\right)+jp\left(l+\frac{L_1}{d}\right)\right\}d. \quad (9)$$

In actual practice the inductance of the length d of the cable between the loading coils is negligible compared with that of the loading coil, and the resistance of the loading coil is small compared with that of the length of cable between the loading coils. Hence, it is sufficient to write the above equation in the form

$$v_1-v_2=i_n(R+jpL)d, \quad (10)$$

where R and L are the average resistance and inductance of the loaded cable per unit of length of the circuit. Hence, from (7) and (10) we have

$$i_{n-1}-2i_n+i_{n+1}=i_n(S+jpC)(R+jpL)d^2 \quad (11)$$

If the current is a simple periodic current then i_n may be taken as proportional to $\cos(pt-qx)$, where $p=2\pi/\tau$, and $q=2\pi/\lambda$ and $x=nd$. The equation (11) then becomes, by substitution,

$$\cos(pt-q(x-d))-2\cos(pt-qx)+\cos(pt-q(x+d))=\cos(pt-qx)\{RS-p^2LC+jp(CR+LS)\}d^2 \quad (12)$$

But since $-p^2=(jp)^2$ equation (12) can be written

$$(jp)^2+2\left(\frac{R}{2L}+\frac{S}{2C}\right)jp=-\left(\frac{4}{LCd^2}\sin^2\tfrac{1}{2}qd+\frac{RS}{LC}\right) \quad (13)$$

Solving this quadratic we have

$$jp=-\left(\frac{R}{2L}+\frac{S}{2C}\right)\pm j\sqrt{\frac{4}{LCd^2}\sin^2\pi d/\lambda-\left(\frac{R}{2L}-\frac{S}{2C}\right)^2} \quad (14)$$

Hence the frequency of the oscillations is given by

$$p/2\pi=f=\frac{1}{\pi d}\sqrt{\frac{1}{LC}\sin^2\pi d/\lambda-\left(\frac{Rd}{4L}-\frac{Sd}{4C}\right)^2} \quad (15)$$

Hence the velocity $W=f\lambda$ with which the wave travels is given by

$$W=\sqrt{\frac{1}{LC}\frac{\sin^2\pi d/\lambda}{(\pi d/\lambda)^2}-\frac{\lambda^2}{4\pi^2}\left(\frac{R}{2L}-\frac{S}{2C}\right)} \quad (16)$$

If then, the primary constants R, L, S and C are so related that $R/L=S/C$, that is, if the cable is sufficiently loaded to be distortionless, we have

$$W=\frac{1}{\sqrt{LC}}\frac{\sin\pi d/\lambda}{\pi d/\lambda} \quad (17)$$

Accordingly the cable will not transmit a wave if the frequency f is increased to a point at which f is greater than $1/\pi d\sqrt{LC}$, that is, if the periodic time T is less than $\pi\sqrt{Ld.Cd}$. If the wave-length is made less than the coil or load interval d, then, as shown by Mr. Godfrey (*loc. cit.*), there are curious discontinuities as the wave-length is progressively decreased. We are presented with a phenomenon analogous to the formation of absorption lines in spectra, in which a medium is transparent or more or less opaque in accordance with the wave-length of the incident light. If, in the formula (15) above, we put $S=0$, it becomes identical with the formula given by Pupin. If we put both R and S equal to zero, and if d/λ is small, then the wave velocity becomes $1/\sqrt{LC}$, and is the same as if the added inductance is uniformly distributed along the cable.

The Admiralty have accepted a tender for an important extension of the naval wireless station which is situated on Horsea Island, in the upper reaches of Portsmouth Harbour. At the present time the aerials are 180 ft. in height, but these are to be replaced with 400-ft. aerials, and the electric installation will be also improved, enabling communication to be established, it is understood, with all parts of the Mediterranean.

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Off the Labrador Coast

By W. A. APPLETON

IMAGINE a barren and desolate land stretching away as far as the eye can see into bleak, unbroken solitude. Such is the rocky coastline of Labrador, washed at all times by a tumultuous grey sea, and

An Ungava Eskimo wearing the wireless 'phones.

with scarcely a patch of verdure to relieve its gauntness.

Occasionally a fall of snow will cover up these bare ribs of Mother Earth with a glistening mantle, but at other times, especially during early autumn and late spring, it is repellent in its nakedness; while the sound of waves dashing against the rocks and the cries of innumerable sea birds seem to the imagination of the lonely voyager to be hostile voices, warning him off from these inhospitable shores. And yet the hardihood of man has paid no heed to such warnings, for off the Labrador coast fisher folk, not in single spies, but in battalions, carry on a lucrative and increasing business; thither, too, the fur trader makes his way to meet the Eskimo coming south from still more desolate regions and bargain the price of mink and sable and silver fox. But for all this it must not be imagined that the evidences of life and commerce on this coast are frequent. No! The distances to be covered are so great, and the visits of "creation's lords" so short, that they are lost in the waste immensity.

It would be strange if mankind did not do something to ameliorate the conditions of those who are forced by circumstances to journey thither; so that the reader will not be surprised to learn that "Marconi" has already been inaugurated on the coast and has brought the influence of civilisation to a country which is never likely to know the luxurious conditions of life which prevail in more temperate zones.

Nine Marconi stations are already in working order in Labrador. They are: Battle Harbour, Venison Island, American Tickle, Domino, Grady, Indian Harbour, Holton, Cape Harrison, and Mokkovik Harbour, and the list has been placed in order of the situation from Newfoundland northwards. Except in smaller details their equipment is identical. For the sake of efficiency, and because there is no question of "jamming," plain aerials have been used in all the stations, and have always proved most satisfactory. The distances between station and station are comparatively short, but work is not always easy, owing to the rocky land which lies between them, though up to the present communication has never failed. All stations are frequently used by the deep sea fishers, who, when commencing their season's work, always inquire first of all whether the station near their field of operations is in working trim.

The reason for their inquiry is that the stations are actually closed down during the winter, for then the coast is icebound, and no fishing vessel dare journey northward, but as soon as the weather breaks the operators in charge of these stations are shipped back to their posts, and everything

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is in readiness for the approach of the fleets. Nor would any fleet be so rash as to set out on its journey without first knowing that the stations are opened for work. More especially for this reason the markets are so well regulated, and competition is so keen that the master of the vessel must have tidings of the market affairs if he is to "place" his catch to advantage. Moreover, he requires information of prevailing meteorological conditions, the state of the ice, and other matters directly applying to navigation. As soon as satisfactory news has been received from the stations in nine operators on board. The *Kyle* is especially adapted for work of this kind, and with its sister ship, the *Invermore*, is fitted with wireless. It was built in England, and was only launched in the early part of last year. The wireless equipment consists of a Marconi 1½ kw. rotary converter set. Every fortnight she makes a trip round the stations, bringing provisions and mails, and in order that she may be able to plough through the icefields she is constructed on a special design and fitted with ice breakers. On the journey in question she had not travelled far before she found

Battle Harbour from the Station Hill.

question the fleets get together, and arrangements are made to set sail on a certain day; last year this day was fixed for May 31st.

The vessel carrying the Marconi operators is necessarily the forerunner in the advance northwards, and the experiences are not without interest to the outside world. We will accompany one on the journey from station to station, which is made from year to year. Each time, of course, fresh work has to be done and fresh incidents occur, but in general details one trip is like another, so for the purpose of centralising our tale we will take the journey which was made last year.

On June 3rd the steamship *Kyle* started from St. John's, Newfoundland, with the herself in a field of heavy ice, which extended for over 50 miles, and necessitated very slow progress, for it is hard work making headway against the heavy pressure of the icefloes, and great skill is required in navigating the vessel, lest this pressure should produce too great a strain on her sides or fix her so fast that it might be a question of weeks or months before the ice would give way sufficiently to allow her to proceed.

It is not an unpleasant experience to go through an icefield, especially if the weather —as it was on this occasion—is fine, for then the sight is wonderful—leagues of dazzling white ice sheets which, for all their intrinsic purity, take on prismatic colourings and

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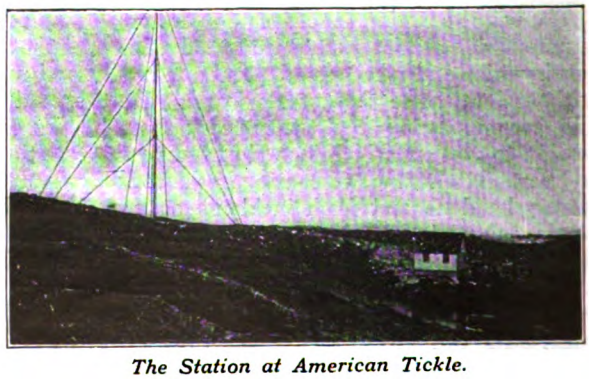
radiate the light flooding over them from the depths of a clear blue sky. Here and there, where the ice is broken up into patches, it is for all the world as if the ocean had blossomed out into gigantic snowy flowers, floating like water-lilies upon the dark green waves the depth of which is intensified by the wonderful contrast.

Raising the new mast at Cape Harrison.

At last Belle Isle was reached, and after that journeys were made to Venison Island, American Tickle, and Domino without much delay, but such was not the case in the progress to the next station, for before Holton was reached the *Kyle* found herself in a thick impasse which was proof against all skill and ice-breaking appliances, so that she had to give up this part of her journey and turn back to St. John's, and wait till the next trip to visit the more northerly stations. Even then her work was difficult, for the wintry conditions were stubborn, and it was late in the year before oncoming Spring had made her influence felt; when Mokkovik, the most northerly point, was reached the calendar had already registered July 8th.

The most important work that was done this season was the reconstruction of the Cape Harrison station. Labrador is noted for its terrific gales of wind and "glitter" storms. In the previous winter one such storm had done vast damage to the whole coast, and under its phenomenal onslaught the mast at Cape Harrison had broken down. The Cape is a hill of about 900 feet high, with almost perpendicular sides, and the station is situated on its summit. It is banked with heavy baulks of wood in order to secure it against the wind, but even this cannot always ensure it against damage. It was such damage that had now to be rectified, and four men were landed to complete the work. The process of conveying the men to the station was not difficult; an old skiff was launched, and soon the little party was landed; but it was quite another thing to land the material for the new mast and the provisions. The little boat, laden with heavy cargo, began to make water long before the harbour was reached, and the occupants had to bale for all they were worth to keep her afloat, and it was easy to see that if everything was to be landed safely the work had to be done expeditiously.

It was thought inadvisable to make for the usual landing stage, but to beach the boat on the nearest rock. This was done, and then commenced the laborious task of conveying the goods to the station up the precipitous cliffs; and it speaks well for the energy displayed that, with the exception of a few provisions, everything was satisfactorily transferred. Then the work of erection was commenced, and this occupied the full attention of the party. It was as well that this was so, for Cape Harrison is a lonely situation at the best of times; but this year, owing to the lateness of the season, no fishing schooners had yet arrived, so the little party of wireless enthusiasts were cut off from all the world until the station had been repaired. The work of



The Station at American Tickle.

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erecting the new mast was started without delay. Entirely new steel sections were used in its construction, and it was secured as firmly as any two 63-ft. steel masts with horizontal aerials can be secured by human toil, and it will have to be a very strong gale indeed that will reduce it to the conditions of its predecessor. The collapse of the old mast was found to have been due to the entire set of northern stays giving way owing to the opening of the turnbuckle ends, but with the new equipment this is not likely to happen again. Within as short a space of time as possible communication was set up with the Holton and Mokkovik stations.

Labrador, in spite of its bleakness, is the scene of much activity between the months of June and August, and the stations are kept busy reporting catches of fish, orders for salt, and many other matters in connection with the fishery. The operator at this time has plenty to interest him. The hauling of traps, then the "making" of the fish, are scenes of daily occurrence, while every now and then a fisherman will drop in to exchange news or send a Marconigram, and is only too willing to pour his tale of adventure into sympathetic ears.

Then, in time off, good sport is to be obtained with the partridges and hares which abound in Cape Harrison, and an hour's shooting will often provide the station with dainty fare for many days.

Occasionally a few Eskimo will come down to meet the fur traders, and already they are becoming accustomed to the institution of wireless, and will sometimes pay the station a visit. Among such visitors last year was a young native of Ungava, who was on his way south to complete his education and to gain some sort of culture from civilisation. He was particularly intelligent, and took much interest in the wireless apparatus. Finally he was persuaded to be "snapped" with the wireless 'phones on his ears, and is probably the first of his race to be so photographed. Clad in his quaint native costume, with this anachronistic headgear, he makes an interesting portrait for THE WIRELESS WORLD.

But summer in Labrador is a fleeting visitor, and in the middle of October orders were received by wireless that the stations were to be dismantled and closed up for the winter and the operators were to be ready for the arrival of the steamer which was to take them back to Newfoundland.

By November work was completed and solitude was left in supreme possession of the Rocky Coast of Labrador.

Labrador Puppies from Seal Islands.

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Wireless for Railways

FURTHER EXPERIENCES ON THE LACKAWANNA. ADDITIONAL STATIONS TO BE CONSTRUCTED.

THE successful application of wireless telegraphy to railways as evidenced by the achievement on the Delaware, Lackawanna and Western Railroad, reported in the February number of this magazine, has aroused the keenest interest in Europe, particularly in railway and engineering circles, where, it is not too much to state, the news was received with no little surprise.

Since that article appeared we have received further information concerning the system which may be regarded as demonstrating its efficiency without any doubt.

Wireless telegraph messages were sent and received on January 22nd without interruption by an operator on a special train on the Delaware, Lackawanna & Western Railroad, travelling from 50 to 75 miles an hour, which carried 500 members of the American Society of Civil Engineers from Hoboken to Nicholson, Penn., and back.

Mr. George A. Cullen, Passenger Traffic Manager of the Lackawanna Road, who was on the train, sent to *The New York Times* the first wireless dispatch from a moving train to a newspaper, which read as follows :

New York Times, New York :

> On board Lackawanna Civil Engineers' special, 35 miles east of Scranton, Penn., going sixty-four miles an hour. Greetings in the first wireless message from a moving train to a newspaper. CULLEN.

This message was despatched ahead of the train to Scranton and sent from the wireless station there direct to the American Marconi Co.'s station on the Woolworth Building, from which it was delivered to *The Times* office. It was six minutes from the time the message was handed to the Marconi operator on the train until it was copied by the operator on the Woolworth Building, and no wire transmission was used. The distance covered was about 125 miles.

Shortly after this message was received Mr. Hunter McDonald, President of the American Society of Civil Engineers and Chief Engineer of the Nashville, Chattanooga & St. Louis Railroad, sent another to *The Times*. The train was then twenty-five miles west of Scranton, travelling at the rate of seventy miles an hour. The message read :

The New York Times :

> The members of the American Society of Civil Engineers send you wireless greetings from their special train on the Lackawanna. No S. O. S. call is likely to be heard, as Phoebe Snow is in charge.
>
> HUNTER MCDONALD, President.

More than thirty wireless messages were received and sent by the Marconi operator on the train during the day. Greetings were exchanged between passengers and their friends in New York, and news items from Scranton were received on the train.

When the train was thirty-two miles east of Scranton in the afternoon on the return trip, the *Scranton Times* sent bulletins of news to it. They were :

> Battle is expected at Torreon, Mexico, at any hour. Federals are strongly entrenched.
>
> The task of raising the sunken British submarine A7 begins in the White Sand Bay. Huge hawser passed under the vessel.

Mr. William H. Truesdale, President of the Delaware, Lackawanna & Western Railroad Company, sent a wireless message from his office in New York to Mr. McDonald. The message was received when the train was thirty miles east of Scranton. It read :

> Hunter McDonald, President of the American Society of Civil Engineers en route Lackawanna Railroad.
>
> My cordial greetings to yourself and fellow-members of the society, wishing you a very comfortable trip, and that you

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will find much to interest you during your visit to our new Clark's Summit-Halstead cut-off line. WILLIAM H. TRUESDALE.

Mr. McDonald replied to Mr. Truesdale by wireless. He said :

William H. Truesdale, President.

Thanks for your wireless message. The members of the society on your special excursion train to the viaduct greatly appreciate your interest and the care you have taken for our comfort. We may Lackawanna, but we lack nothing else.

HUNTER MCDONALD.

A most convincing demonstration of the efficiency of the wireless telegraph was given when the train was twenty-five miles east of Scranton on the return trip. Several of the passengers who had heard about Mr. McDonald's messages to Mr. Truesdale and *The New York Times* went to the wireless operator's cabin and asked to see the original messages. Mr. Sarnoff, Chief Inspector of the Marconi Wireless Telegraph Co., of America, who equipped the train, was in charge. He said that the Lackawanna operator who had sent the messages had left the train at Scranton, taking the original messages with him. He immediately sent a wireless call to Scranton, however, got into communication with the operator, and, while the passengers looked over his shoulder and watched him write them, he received both messages from Scranton. They did not differ in a word or comma from those sent originally, and five minutes after the passengers asked for them they were in their hands.

Wireless stations are now being constructed at Lake Hopatcong, N.J., forty-six miles from New York, on the Lackawanna Road, and Bath, N.Y., 100 miles east of Buffalo. When they are finished the Lackawanna, with the stations at Scranton and Binghamton, will have four stations on its line with overlapping radii, so that at no time between Hoboken and Buffalo will a train equipped with wireless instruments be out of communication with a fixed station.

Both the east and west bound Lackawanna Limited trains, which run between Hoboken and Buffalo, will begin to handle commercial messages as soon as these stations are completed.

Directory of Amateur Wireless Stations.

THE announcement in the December number of the WIRELESS WORLD, that we proposed to publish a Directory of Amateur Wireless Stations, has been received with satisfaction in amateur circles in this country, and has brought a generous response to our invitation to amateurs owning licensed stations to supply us with particulars of these stations for publication in the directory.

We feel, however, that we have not by any means heard from all the amateurs who possess a Post Office Licence, and we believe that many who are not connected with any wireless society have either overlooked our notice, or have not yet taken the trouble to send us the particulars asked for. If there are any such amateurs, we would ask them to favour us with particulars of their stations at an early date, so that we may proceed with the preparation of the directory, which will then be complete in every respect.

We feel confident that in the compilation of this directory we can rely upon the assistance of the members of the amateur wireless societies, and others who are not associated with those organisations, and to whom the existence of a reliable directory will prove of inestimable value.

We shall be glad, therefore, if readers will send us, at an early date, the following particulars for inclusion in the directory :

Name and address.

Call-letters.

Whether the station is for transmitting and receiving, or receiving only.

Transmitting range, in miles.

Transmitting wave-length, in metres.

Receiving range.

Usual hours of working.

General remarks.

Secretaries of wireless associations and clubs will oblige by sending names of their officers, address of headquarters, call-letters and any other useful information.

This directory, when complete, will be distributed free of charge to our readers.

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Administrative Notes

Australian Inland Communication.

Residents of Casterton and Strathdownie, in Victoria, Australia, expect to be able shortly to communicate by wireless. The Commonwealth Postmaster-General (Mr. Wynne) has issued instructions for the stations to be erected as expeditiously as possible, as he is anxious to have a practical test as to the efficiency of the system before establishing communication of the same kind between other centres.

* * *

Operators' Certificates in Brazil.

The Brazilian Government have published a notice in the *Diario Official* recognising the certificates given by the Marconi school in Brazil as official. The Director of Posts, Telegraphs and Illumination has been ordered to *visé* the certificates, and the Treasury has been ordered to register them. Under the new wireless regulations which have already been approved of by the Government, and which are shortly to be published, all the operators on ship and shore stations must have a diploma conferred by a recognised school and *viséd* as above. No further licence is required by the operators. At present the Polytechnic and the Marconi school are the only schools officially recognised for granting certificates.

* * *

Regulations for Cargo Vessels carrying Explosive Gas.

The following notice, dated January 9th, has been issued by the Department of Commerce, Washington, U.S.A., to the Government wireless telegraph inspectors: "When inspecting the radio apparatus on tank vessels or cargo vessels carrying gasoline or similar substances which generate an explosive gas or any other explosive which might be ignited by electric sparks caused by the operation of the radio apparatus, you will pay particular attention to the insulation of the antenna, to metallic rigging or equipment of the vessel in which currents may be induced by the action of the radio apparatus, and to the wiring and electrical equipment of the vessel in which currents may be induced by radio apparatus so as to cause sparks to jump between wires or between small gaps. In general this matter should be brought to the attention of masters of vessels, steamship owners, and wireless telegraph companies. If upon inspection sparks of the above character are found, the matter will be reported to the master of the vessel, the steamship company or its agents, and to the company operating the wireless apparatus, and the dangers pointed out."

* * *

Coast Charges.

Commencing January 20th, the coast charge of the Havana (Cuba) Radiotelegraph Station (Call letters HV), was: For messages exchanged with vessels in the Trans-Oceanic service, 4d. per word, with a minimum charge for 10 words; for messages exchanged with vessels in the American coastwise service, 3d. per word, with a minimum of 10 words. This station is operated and controlled by the Marconi Wireless Telegraph Company of America.

According to the *Telegraph and Telephone Age*, James Dunlop Smith and Elmer E. Burlingame, who were convicted on January 1st of having used the mails to defraud, in connection with the sale of stock of the Radio Wireless Telephone Co., were sentenced, on January 7th, in the Federal District Court, New York, by Judge Hunt. Smith, who had been president of the Radio Wireless Telephone Co., was sentenced to twenty-one months' imprisonment in Atlanta Penitentiary and to pay a fine of $5,000, and Burlingame to two years and six months in the same institution and to pay a fine of $10,500. The Ellsworth Co., which was also a defendant, was fined $10,500.

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NOTES OF THE MONTH

WIRELESS FOR INLAND COMMUNICATIONS. SOLVING THE SERVANT PROBLEM IN AUSTRALIA. STEAM TRAWLERS AND WIRELESS. A NEW ELECTRIC WAVE THEORY. THE SHARE MARKET. HONOURING CAPTAIN INCH.

The example of the Postmaster-General in deciding to substitute wireless telegraphy for the existing overhead land lines in exposed parts of the United Kingdom is to be followed by the Government of the Commonwealth of Australia, so as to bring outlying country districts into permanent communication with all the towns and business centres. It is stated that twelve wireless installations will be established immediately in the country districts of Queensland and New South Wales. These are expected to be ready in the course of a couple of months. Experiments will then be carried out to test their reliability, and should these prove successful, as they are expected to do, steps will be taken immediately to link up all the isolated settlements in Australia by means of wireless installations. The Federal Government have also decided to employ wireless telegraphy as an aid to the construction of the transcontinental railroad and to the operation of trains. Parts of the route through which the railway is to run are frequently visited by severe storms, and wire communication suffers much in consequence. In this there are the Marconi Company's successful experiences in America as a guide.

* * *

A novel fact that we announced some months ago has now received confirmation in a Government publication. We pointed out that the demand for domestic servants in Australia was so great that often women immigrants were engaged by wireless telegraphy while on the high seas and before the ship sighted land. This fact has been discovered also by the Dominions Royal Commission, who have just concluded their sittings in London and who issued, at the beginning of last month, a report in which appears the following interesting paragraph: "The demand for female domestics, both in Australia and in New Zealand appears to be imperious and practically unlimited. In some cases, before a ship carrying women migrants sights the land a large number of its passengers have been engaged by wireless telegraphy. In other cases would-be employers go out in tugs to meet it. On the day of its arrival in port, or on one of the following days, according to the varying customs of different places, something recalling the scene of the hiring fair takes place at the receiving homes or the Labour Bureau. Intending employers attend in hundreds, and all the servants with any pretensions to skill and character are engaged at once." To the overworked colonial housewife wireless is, therefore, a boon which she probably never contemplated.

* * *

With the result of Messrs. Hellyer's experience before him, Mr. G. L. Alward had every justification for advocating, as he did when speaking at the prize distribution of the Grimsby Technical School for Fishermen, that "all steam trawlers should be equipped with wireless apparatus." Vessels now venture into the Arctic Circle in mid-winter in search of fish food, a thing undreamt of but a few years ago. Fishermen have to face every conceivable peril of navigation, and anything which can be done to lessen the risks of their calling should be done. Vessels sometimes get fast in the ice in northern latitudes, and if only there were means of communication it is possible that such distressing calamities as that of the loss of the *Monimus* might be avoided. Mr. Alward appealed to the Corporation to include wireless telegraphy as one of the studies at the school, and to trawler owners to equip their ships with the necessary apparatus. It is encouraging to note that Alderman Sir George Doughty, M.P., and other members of the Education Committee who were present at the prize distribution, expressed approval of Mr. Alward's suggestion and promised it their support

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A mild sensation was caused during the past month by the report that "a well-known French engineer" (of whom, by the way, we do not appear to have heard before) had "discovered" that "dangerous explosions are liable to occur at the meeting points of wireless electric waves." This startling theory was backed by the reminder that "the *Volturno* disaster took place just at the junction point of the Eiffel Tower and Glace Bay wireless lines (!) and the recent mining explosion near Cardiff on the Clifden-Paris line (!), while Toulon, where the explosions on board the battleships *Jena* and *Liberté* occurred, is on the Paris-Bizerta line." Some of our friends in the press appear to have taken this report seriously, and one writer has become so scared by the horrible possibilities which lie ahead (according to the latest theory, of course) that he demands "prompt and thorough measures of prevention, even if the rapidity of the development of wireless telegraphy is checked by them." We hope that timid persons will accept our assurance that nothing of the kind predicted can happen. Anybody at all acquainted with wireless knows that the waves do not leave the station like a bolt! They spread out like a vast fan; therefore, if you send a message from England to America the waves are meeting at an indefinite number of points right across the Atlantic.

* * *

A graceful act of recognition to heroism was performed at the Mansion House on February 4th, when Captain Inch of the *Volturno* was presented by the Lord Mayor with the *Quiver* Hero's gold medal, a gold watch and chain, a silver casket to contain a certificate of the Freedom of London, and Mrs. Inch with a diamond and sapphire pendant and an afternoon tea service.

The Lord Mayor, in making the presentation, briefly and very aptly referred to the hero's work in the following words:—

> "We ask your acceptance of the accompanying gifts in recognition of your heroism and staunch allegiance to duty during the burning of the S.S. *Volturno* in mid-Atlantic on October 9th and 10th, 1913. For upwards of 24 hours the lives of more than 500 passengers and crew were in the gravest peril. But for your coolness and daring, your unfaltering courage and personal sacrifice, the loss of life must have been appalling. You averted a great maritime disaster. Lord Desart, as President of the Board of Trade inquiry into the burning of the *Volturno*, commended your conduct in the highest terms, and no greater tribute could be paid to any man than the eloquent words he applied to you—'He did his duty.'"

* * *

Mr. Marconi, who was present, endorsed the sentiments expressed by the Lord Mayor, adding that he was very glad to accord his tribute to the heroism of Captain Inch. It was the greatest possible satisfaction to him that wireless telegraphy and those who were working it were not found lacking in what they meant to do, even to the extent of summoning the far-distant oil-tank *Narragansett*. The story of the disaster showed that while they lived in a mechanical age of steamships and wireless telegraphy sailors were still as prone as ever to heroism. One of his greatest happinesses was that his work brought him into close touch with sailors. All who had to do with wireless telegraphy were proud that it made communication possible which formerly was not possible, and that it was able to bring assistance to ships in distress.

Captain Inch, on rising, returned thanks in an admirable little speech, concluding with the remark, which all who have followed the story of the disaster and the work of rescue know to be fully justified, that "thanks were especially due to Mr. Marconi, since had it not been for his wonderful invention they would have all perished in the *Volturno*."

* * *

The Share Market.

LONDON, *February 20th.*

Since our last share market report there has been considerable activity in the various Marconi issues, Marconi Ordinary touching £4 3s. 9d. Prices, however, are now lower in sympathy with the general dullness of stock markets. Marconi Ordinary, £3 13s. 9d.; Marconi Preference, £3 1s. 3d.; Canadian Marconi, 10s. 0d.; Spanish Trust, 12s. 6d.; American Marconi, £1 1s. 3d.; Marconi International Marine, £1 13s. 9d.

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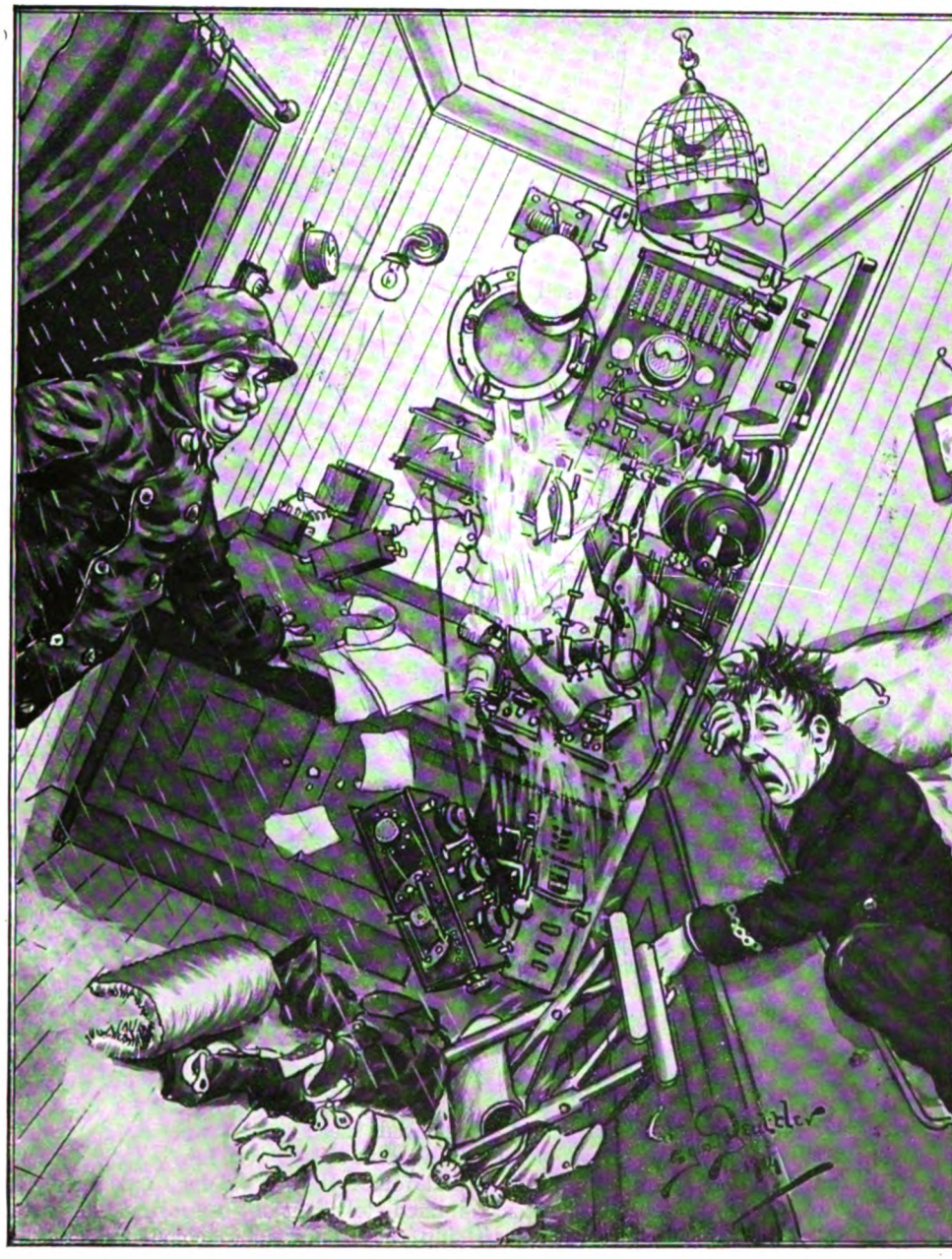
CARTOON OF THE MONTH

WIRELESS WORRIES—III.



AN OPERATOR'S FIRST TASTE OF BAD WEATHER.

QUARTERMASTER: "The Capt'n wants to know if yer've got Poldhu yet, sir?"

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Maritime Wireless Telegraphy

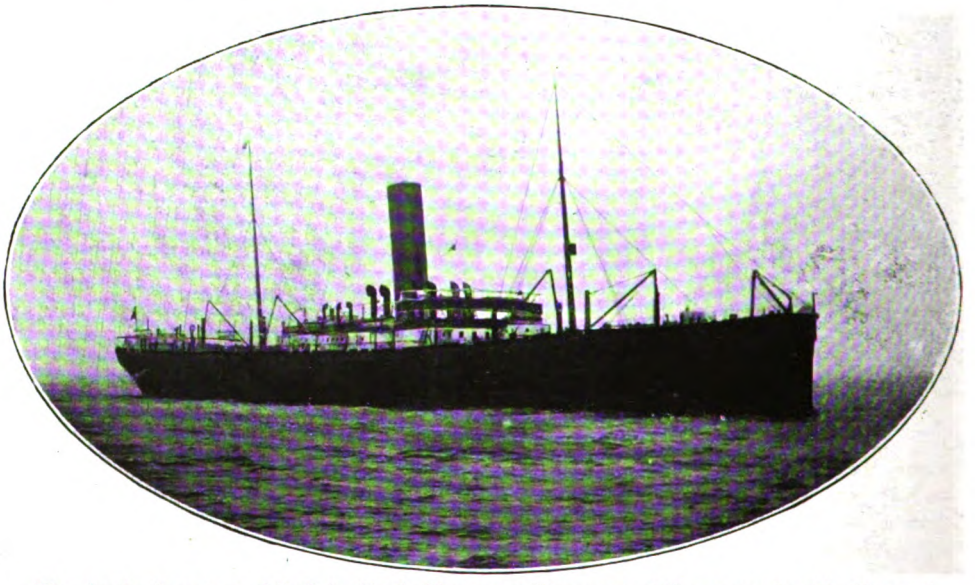
THE most conspicuous of the maritime annals of last month was the stranding of Mr. Vanderbilt's yacht the *Warrior* off the Colombian coast.

The disaster occurred on Tuesday, January 28th, when the *Warrior* struck one of the most perilous parts of this dangerous coast, a part which is popularly known as "The Graveyard of Ships," between Savanilla and Santa Marta. The accident occurred at 6 o'clock in the morning, when the cry "Breakers ahead!" was raised by the look-out, and immediately afterwards the vessel touched bottom. She had struck rocks which, owing to the high sea and the spray-charged atmosphere, were only visible a moment before. Then she slipped off again, a mere plaything in the clutches of gigantic waves. Finally she came to rest with her sides battered hard against the rocky coast formation.

The crew endeavoured to back the vessel off into deep water, but abandoned their attempt when it became apparent that, owing to the nature of the ship's injuries, such a course might sink the *Warrior* even more quickly than in its present perilous situation.

Repeated calls for help were sent out by "wireless," but it was not till noon that the message was picked up by the *Frutera*, one of the United Fruit Company's line, which immediately headed to the work of rescue. Already the position of the *Warrior* had become so perilous that the crew of the yacht were about to launch the lifeboats when they received the *Frutera's* reassuring message. The rescue ship arrived late in the afternoon, and found they were none too early, and immediately sent out messages to her sister-ship the *Almirante* to come and assist in saving the disabled vessel.

The party on the *Warrior* (which included the Duke and Duchess of Manchester and



The Anglo-American Oil Co.'s Tank Steamer "Narragansett," equipped with Marconi apparatus, which was one of the vessels responding to distress call of the ill-fated "Volturno," and which rendered splendid service on that occasion.

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Lord Falconer, the son and heir of the Earl of Kintore, besides Mr. and Mrs. Frederick Vanderbilt), had for the last few hours been veritably face to face with death, as they waited, lashed to the rails of the derelict vessel, for an answer to the wireless call for aid.

The *Frutera* lost eight lifeboats trying to reach the shipwrecked party, and would herself have gone ashore had it not been for the arrival of the *Almirante*. A terrible sea was running and the wind blew a gale. The first boat launched was smashed almost before it reached the water, several sailors being stunned as they were hauled against the steel sides of the steamer. The succeeding boats were capsized almost immediately they were launched, and their crews were only saved from drowning by the timely throwing of lifebuoys. In the end all were picked up safely, but in some cases it required much time to resuscitate them. For three hours this hopeless work proceeded; then came the *Almirante* in response to the *Frutera's* call. The sea was now less stormy, and two boats were lowered from the *Almirante*; together they were successful in reaching the *Warrior*, and in taking her passengers off, but the captain and crew refused to leave the vessel in the hope that they might be able to save her when the high seas abated.

As soon as the rescue party were aboard, the *Almirante* returned to Colon, the *Frutera* remaining to stand by the wreck, and she was assisted in her watch by a salvage steamer which put out from Jamaica immediately on receipt of the news.

For the next few days the captain and crew of the *Warrior* remained on their vessel, but their heroism did not jeopardise their safety, while their relatives at home were kept assured that all was well by continuous messages, which were sent from the vessel to New York.

Unfortunately hopes of salvage were destined to be disappointed, for shortly after the passengers had been taken off the vessel shifted into a still more difficult position, and finally it had to be abandoned as a total wreck.

The *Warrior* was one of the finest yachts floating; she was of steel construction, 282 feet long, had twin screws, and was equipped with wireless apparatus by the Marconi Wireless Telegraph Company of America. She was a schooner rigged with a large funnel and graceful clipper bows, on which was a figurehead of a "Warrior" with a gleaming sword over his shoulder, similar to that borne by the old British battleship of the same name.

* * *

The Liverpool Salvage Association's steamer *Ranger* has arrived in the Liverpool docks after successfully salving the Stott liner *Ussa*, which, with a valuable cargo, ran ashore on the Hebrides. Before going to her berth at Holyhead the *Ranger* is to be equipped with Marconi wireless, which has already been installed in the salvage boat *Linnet*, stationed at Southampton.

The Argentine Government radiotelegraphic station at Cape Virgenes was destroyed by fire early in the New Year.

* * *

An outbreak of fire in the power house of the new Post Office wireless station at St. Just (Cornwall), on February 15th, did considerable damage. The fire brigade were summoned from Penzance, but the outbreak had been got under by the local men before their arrival. The roof fell in and the apparatus was put out of operation.

* * *

Ten years ago a boy and girl *affaire* was brought to an end through a proposal being lost in the post, but the error of the mail system has at last been rectified by a marconigram, for Mrs. Frances Thompson while on a recent voyage across the Atlantic received another offer of marriage from her aforetime suitor and marconied her acceptance. The man in the case is a Mr. F. Macintyre, who in the early days lived at Leith, Scotland, where Mrs. Thompson resided as a girl. On reaching manhood he emigrated to America to make his fortune, and this accomplished he sent the proposal which was fated never to reach its destination. The romance seemed at an end, and the girl married. A year ago her husband died, and last Christmas Mrs. Thompson decided to visit some friends in America. Hearing of this, Mr. Macintyre, trusting no longer to the vagaries of the post, wirelessed his important message—and the invisible agent did the rest.

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INSTRUCTION IN WIRELESS TELEGRAPHY

(End of First Course.)

Aerials.

[The first article of this series appeared in the May 1913 number of THE WIRELESS WORLD. This article completes the first series, and special attention is therefore directed to the announcement concerning the examination which appears on p. 758 of this issue. Back numbers of THE WIRELESS WORLD in which the earlier articles have appeared will be sent by the Publisher at Marconi House, Strand, London, W.C., on receipt of remittance of 5d. per copy.]

69. The function of the aerial of a wireless telegraph station is twofold.

In the first place, oscillatory currents flowing in the aerial will cause disturbances in the ether surrounding the aerial, which disturbances radiate in all directions in the form of pressure waves.

In the second place, any disturbances in the ether surrounding the aerial, such as those caused by the passing of a pressure wave, will produce oscillatory currents in the aerial.

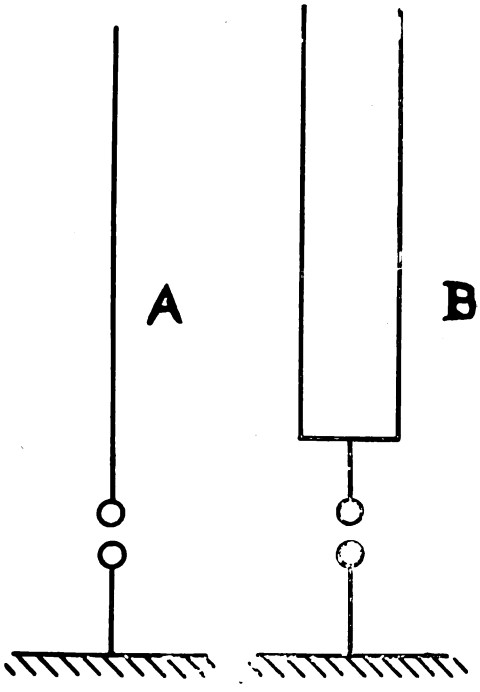

Fig. 1.

Thus, by connecting the aerial either to the transmitting instruments, which are designed to induce oscillatory currents into it, or to the receiving instruments, which are designed to detect oscillatory currents flowing in it, the aerial is used both for transmitting and receiving messages.

70. The first essential of the aerial is to be a good "radiator" and a good "responder."

The second essential is that its electrical dimensions should be suitable for the wavelength it is desired to transmit or receive.

The third essential is that it should be convenient to erect and use.

Efficiency of an Aerial.—Taking the first point, we find that any aerial that is a good "radiator" is also a good "responder."

We also find that its efficiency as a "radiator" increases very rapidly as its average height above the ground is increased; in fact, we find that if we double the height of the aerial we double the range of the station without any increase in the power.

It is important that the number of wires and the size of the wire forming the aerial is sufficient to carry the current which is induced into it by the transmitter without excessive loss due to the resistance of the wire.

The object of these Articles has been to educate the student in the intelligent use of the apparatus for small stations, particularly small portable stations, and as the currents dealt with in such stations are comparatively small, the size and number of the wires in the aerial will not be of great importance.

71. Electrical Dimensions of an Aerial Wire.—The next point to consider is the

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electrical dimensions of the aerial wire, which must be suitable for the wave-length or wave-lengths it is desired to transmit or receive.

The aerial is most efficient as a "radiator" when neither inductance nor capacity have been connected in series with it, and since the only way to increase the wave-length of the aerial circuit is to connect an inductance in series with it, and the only way to decrease its wave-length is to connect a condenser in series with it, it follows that the most efficient aerial is one whose natural or "fundamental" wave-length is that which it is required to transmit or receive.

It is found that the addition of an inductance or condenser in series with the aerial has a greater effect on its efficiency when used as a transmitter than when used as a receiver, so that where an aerial is used for both purposes it **is usual to design the aerial so that its fundamental wave-length is nearest the wave-length used for transmission.**

The addition of an inductance in series with the aerial reduces its efficiency to a less extent than the addition of a condenser, chiefly on account of the losses in the dielectric of the condenser, so that where it is required to transmit more than one wave-length on the same aerial, **the aerial is usually designed to have a fundamental wave-length equal to or shorter than the shortest wave-length required.**

Another reason for this is that an inductance coil suitable for increasing the wave-length of an aerial from, say, 300 metres to 600 metres is far cheaper to construct than a condenser which would be required to reduce the wave-length of the aerial from 600 metres to 300 metres.

72. Fundamental Wave-length. — Every aerial has its own natural wave-length, called its fundamental wave-length, depending upon its capacity and its inductance. If we increase either its capacity or its inductance we increase its wave-length.

In the aerial wire itself these two qualities are, so to speak, mixed, and distributed along the whole length of the wire, so we cannot alter one quality without varying the other.

If we increase the length of the aerial wire, we increase both its capacity and its inductance, and thereby increase the value of its fundamental wave-length, but **if we add on to the aerial another parallel wire, although we increase the capacity of the aerial, we decrease its inductance,** and therefore its fundamental wave-length remains more or less unaltered.

If, however, the additional wire instead of being kept parallel with the original wire, spreads out radially, as in the case of the "umbrella" aerial, and also if its extremities approach the earth, as is usually the case in the "umbrella" aerial, and is sometimes the case in the "T" aerial, then **the capacity of the aerial is increased more rapidly than the inductance is decreased,**

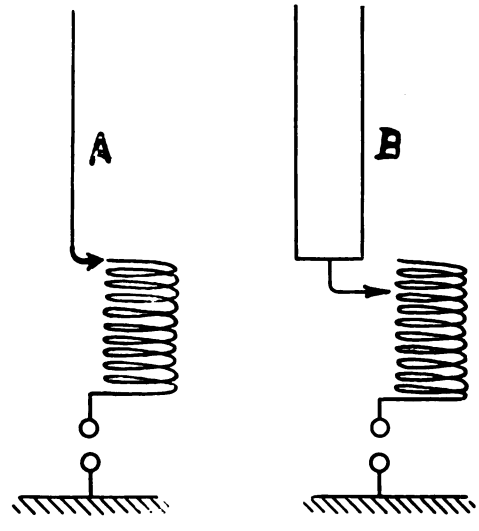

Fig 2.

and therefore the fundamental wave-length is increased.

73. In practice it is found that with single wire aerials or parallel wire aerials, whose wires run either vertically or horizontally with the earth, the wave-length is usually about 4¼ times the length of the aerial. With a "T" aerial, the upper portion of which is kept horizontal with the earth, the fundamental wave-length is about 5 times the length of the aerial, but if the ends of the wires are brought down so as to approach the earth, the wave-length will be still further increased.

With an "umbrella" aerial, the wave-length may be as much as 8 times the length of the aerial, according to the number of

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radial wires forming it and the height of their ends from the earth.

Thus, two or more aerials, both having exactly the same fundamental wave-length, can have different proportions of capacity and inductance.

Two such aerials are shown in Fig. 1, where "A" is a single wire aerial, 100 feet long, and "B" is a two-wire parallel aerial, each wire being 100 feet long.

The fundamental wave-length of both aerials will be about 425 feet, but the aerial "B" will have a greater capacity and a smaller inductance than the aerial "A."

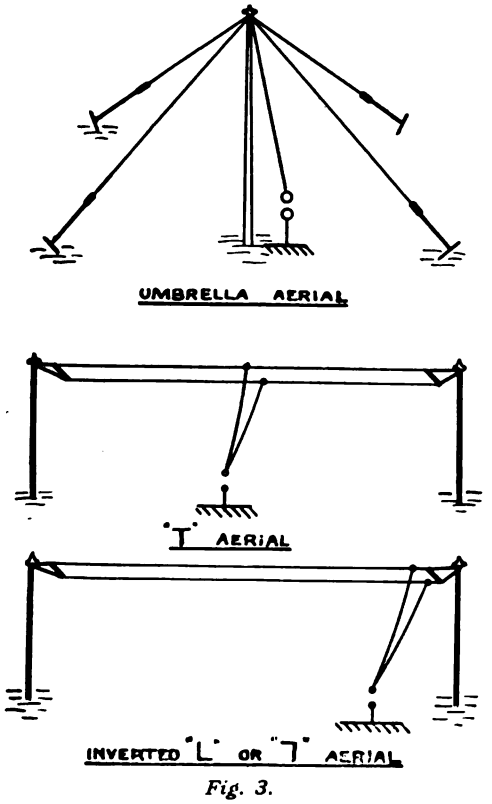

Fig. 3.

Advantage of having a large capacity aerial.—The advantage of having a greater capacity in the aerial is very apparent when we try to increase the wave-length by adding an inductance in series with it.

As already explained, adding an inductance to an aerial reduces its efficiency, so the less inductance we have to add to obtain the required wave-length the better.

74. A larger capacity aerial requires less inductance in series with it to increase its wave-length to a given value than a small capacity aerial, assuming, of course, that the fundamental wave-lengths of the two aerials are the same.

It is quite easy to prove that this is so by the application of arithmetic.

We know that the wave-length is equal to the square root of the product of the capacity and the inductance.

So, if λ = wave-length,
C = capacity,
L = inductance,

then $\lambda = \sqrt{C \times L}$

We will suppose that in both aerials $\lambda = 100$, but in the aerial "B" the capacity is larger, and therefore the inductance is smaller than in the aerial "A." We will suppose that in the aerial "A"

$C = 100$
$L = 100$

and in the aerial "B"

$C = 400$
$L = 25$

then, without any extra inductance,

$$\lambda \text{ of aerial "A"} = \sqrt{100 \times 100} = \sqrt{10{,}000} = 100$$

and also

$$\lambda \text{ of aerial "B"} = \sqrt{400 \times 25} = \sqrt{10{,}000} = 100$$

Now let us add on to each aerial an additional inductance of 100. Then we shall have

$$\lambda \text{ of aerial "A"} = \sqrt{100 \times (100 + 100)} = \sqrt{20{,}000} = \text{about } 141$$

$$\text{but } \lambda \text{ of aerial "B"} = \sqrt{400 \times (25 + 100)} = \sqrt{50{,}000} = \text{about } 224.$$

It will be seen that with the same additional inductance **we have increased the wave-length of the aerial "B" from 100 to 224, while we have only increased the wave-length of the aerial "A" from 100 to 141.**

Thus, if we wished to increase the wave-length of the aerials shown in Fig. 1. from 425 feet to, say, 600 feet, we should find that perhaps 10 turns of an inductance coil would be required in the case of the aerial "A," while only about 6 turns would be required

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in the case of the aerial " B," as illustrated in Fig. 2.

75. Form of Aerial.—The most convenient and economical form of aerial depends entirely upon circumstances.

Height of Aerial.—The higher the aerial the farther we can transmit with the same power, but it may be far more convenient and economical to increase the power of a station than to increase the height of the aerial.

For portable stations it is obviously more convenient to keep the masts as low as we can, for it is essential that they can be put up easily and quickly and that they are not too heavy to carry about.

For stations that are going to be carried by hand or on horseback 30 feet is a very convenient height of mast, for it can be pulled

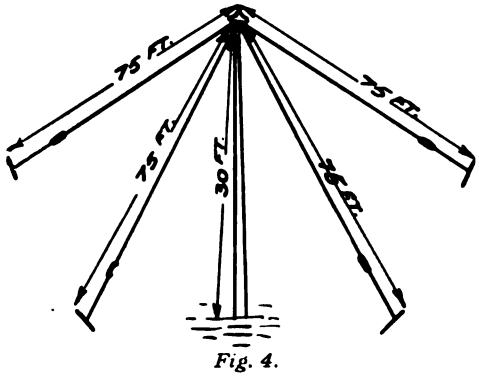

Fig. 4.

up by hand without the assistance of a derrick, and it can be divided up into short sections of 5 feet each, which are easy to handle and pack.

76. Shape of Aerial.—The next thing to consider is the most convenient shape of aerial.

Aerials can be classified under three headings — namely, " Umbrella " aerials, " T " aerials and " Inverted L " aerials. Fig. 3 illustrates an example of each of these forms.

For very small portable stations using short wave-lengths, the " umbrella " aerial is very convenient, as it only requires one mast, and the aerial instead of putting a strain on the mast acts as a set of stays to support it.

Whatever the form of aerial used, one important point to remember is that the farther apart the wires of the aerial are separated the greater the increase in the capacity of the aerial. Moreover, **there is very little advantage in putting two parallel wires less than five feet apart.**

In the case of an " umbrella " aerial, the

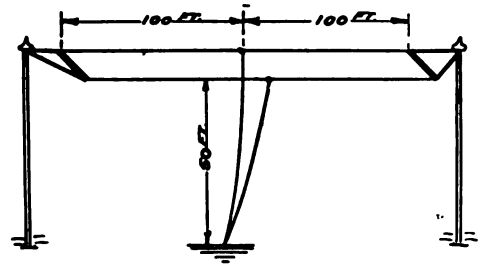

Fig. 5.

wires are usually distributed equally all round the mast, and are therefore amply spaced, but in the " T " or " Γ " aerials, where more than one wire is used, they should be separated by spreaders at each end, which should be at least 5 feet long, and more if possible.

77. The Length of an Aerial.—The length of an aerial is not necessarily the total length of wire, but is the length of wire from the point where it is connected to the instruments or earth, to any one of its extremities.

Thus in the " umbrella " aerial shown in Fig. 4 the length of the aerial is 105 feet, made up of 30 feet of " down-lead " and 75 feet of radial wires.

The length of the " T " aerial shown in Fig. 5 is 150 feet, made up by 50 feet of

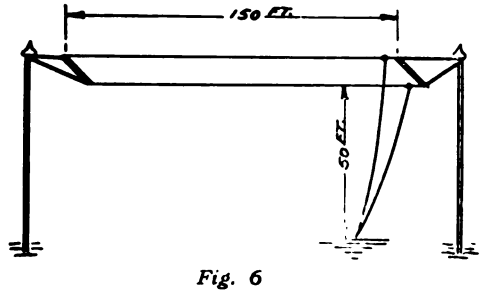

Fig. 6

" down-lead " and 100 feet of horizontal wire in a 200 feet span.

And the length of the " ⅂ " aerial shown in Fig. 6 is 200 feet, made up by 50 feet of " down-lead " and 150 feet of horizontal wire.

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Instruction in Wireless Telegraphy.

THE MARCONI EXAMINATION.

CONDITIONS AND PRIZES.

Important Announcement.

IN this number of the WIRELESS WORLD we bring to close the series of instructional articles which began in May last, and, as then intimated, examinations will shortly be held at suitable centres under the direction of Marconi's Wireless Telegraph Company.

The scheme of instruction and examination was submitted to the Heads of the Territorial Forces, the Boy Scouts' Association, the Church Lads' Brigade, and other organisations, and amongst the letters of approval which have been received are the following from Lieut.-General Sir Robert S. S. Baden-Powell, K.C.B., K.C.V.O., and Major-General Edward C. Bethune, C.V.O., C.B., Director General, Territorial Forces.

Sir Robert Baden-Powell wrote :—

> " Wireless has become a favourite hobby with boys of the right sort, and it is a valuable hobby for them, because it has a big future before it.
>
> " The Marconi Company have seen their opportunity, and have come forward with characteristic energy to help and encourage the boys in taking it up.
>
> " I hope that the Boy Scouts, at any rate, will make full use of the opportunity thus given them, and will, by their good work and progress in efficiency, repay such kindly interest.
>
> (Signed) " ROBERT BADEN-POWELL,
> Chief Scout."

Major-General Bethune, writing to Captain H. Riall Sankey, a director of the Marconi Company, stated in the course of his letter :—

> " I have considered the scheme of instruction proposed by Marconi's Wireless Telegraph Company, Limited, as far as the tuition of lads and Territorials is concerned, it meets with my approval.
>
> (Signed) " EDWARD C. BETHUNE (Major-General),
> " Director General, Territorial Forces."

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We restate here the particulars of the conditions of the examination, together with the prizes to be won.

1. *Territorials and Cadet Battalions.*—1st prize, value 10 guineas; 2nd prize, value 5 guineas; 3rd prize, value 2 guineas; and 5 prizes of 1 guinea each.

The following conditions must be observed:—

(*a*) No one may compete who is professionally engaged in wireless telegraphy, or telegraphy, or is a member of the Territorial Engineers.

(*b*) No one may compete who has not passed his recruits' course.

A complete set of field station wireless telegraph apparatus will be given to that unit to which the first prize winner belongs.

2. *Boys' Brigade, Church Lads' Brigade, and Cadet Corps.*—1st prize, value 3 guineas; 2nd prize, value 2 guineas; 3rd prize, value 1 guinea; and 10 prizes of 10s. 6d. each.

The following conditions must be observed:—

(*a*) Each competitor must be under 18 years of age on the date of the examination.

(*b*) Must have completed at least three months' service.

A complete set of field station wireless telegraph apparatus will be given to the unit containing the first prize winner.

3. *Boy Scouts' Association.*—1st prize, value 3 guineas; 2nd prize, value 2 guineas; 3rd prize, value 1 guinea; and 10 prizes of 10s. 6d. each.

The following conditions must be observed:—

(*a*) Each competitor must be a second-class scout and must be in possession of his signalling badge.

(*b*) Each scout must be under 18 years of age on the date of the examination.

A complete set of field station wireless telegraph apparatus will be awarded to the troop to which the first prize winner belongs, and another set to the troop obtaining the highest percentage number of certificates of proficiency, irrespective of prizes.

With this number we are issuing an Application Form to sit for the examination, which should be filled in and sent to: The Editor, WIRELESS WORLD, Marconi House, London, W.C., to reach him by March 31st. Additional forms may be obtained by sending a stamped addressed envelope to the Editor.

Arrangements are being made for holding the examinations in different centres, and under proper supervision, and candidates under the various categories will be advised of the address of their centres in due course.

The series of instructional articles is being reprinted in book form, and we hope that copies will be ready before the date of the examination.

In the April and subsequent issues of the WIRELESS WORLD, instructional articles will be continued with a view of enlarging the scope of the examinations, which it is proposed shall be held annually. Full particulars of next year's examination and the conditions and prizes relating thereto will be published in the April number.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHAPTER XIII.—*(contd.)*

WAR!

SOON a further message came through, this time from a cargo vessel making hurriedly for Yarmouth Roads. The planes were advancing at a rapid rate, and some score or more had been counted. Charles judged it was time to send out his single emissary against the advancing host. He touched the lever that set the powerful dynamo rotating at full speed. The airship rose steadily out of its hangar—that little bubble on which so much depended!

Swiftly it sped out to meet the enemy's planes like some kestrel defending its home against a swarm of bats. Charles looked through the sighter. The vessel dwindled further and further into the distance, until it was a mere speck.

The rising sun caught its flanks, and showed it up against the blue background. Then it disappeared into the mist. But the electric apparatus was working in the dim light of the shuttered operating room, the little spark shining an electric blue, marking its course on the screen. Yet another message that the planes had been sighted swiftly approaching the shore. Now Charles could see them in the sighter, for with the rays of the sun the fog was swiftly disappearing. On they came, two and three together. It was time to make the airship rise so as to be above them. Up it sped, climbing its spiral ladder heavenwards. Charles panted for breath in his excitement. Now it was poised over the first of the German aeroplanes. With nervous fingers he touched the fateful lever and swiftly it descended, even more like a kestrel in its downward flight, and pounced upon the enemy. The button was to regulate the death-flame. A flash! The mote in the sighter disappeared, only the blue glow travelled unconcernedly down the mirror. Another touch of the keys, and the light turned swiftly round, then reascended the glass; but the airship had to work swiftly now, for not one, but several of the enemy were within reach. A message was sent down that the dynamos should work at their utmost power. It was needed, and now the full benefit of the weary practice of the last few weeks in operating the keys was reaped, for, as a typist types on a machine, so Charles was pressing the keys on his table. Another monoplane was located, another flash sent, and once again the sighter was clear of the mote that troubled it. But another was there, and another. The monoplanes were dangerously close, but the airship had not far to travel. This time it met its enemy face on. The direction of the flash was altered, and the blow sent. It served its purpose. Swiftly it turned to the right as the airship rose into the air once more the conqueror, but only to stand poised over another, which likewise fell beneath its power. By this time the rear-guard of planes had come up, and it was evident that consternation prevailed in the ranks. The airmen seemed scarcely to know what to do. There was no concerted movement with the body. They spread out in skirmishing order, but such tactics little affected the swift onslaught of the defending giant. In a moment Charles made up his mind. He would attack the enemy to the left, for they were most likely to make good their escape if they should chance to get out of reach of the vessel and descend into the wild moors of Yorkshire. It was soon evident that the puny strength of the monoplanes was nothing as compared with the flight of the airship. She caught up one, then another, and each in its turn was sent to

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destruction. The sighter and the mirror veered round on their pivots as the chase proceeded, and Charles heaved a sigh of relief when he saw the last of the black specks clear from the lens. Then he changed the course of the vessel. Swiftly it came round forming a semicircle in an endeavour to catch up with the fleet that made their course to the right, but they had speeded along too fast, and many minutes elapsed before he caught sight of them. At last one appeared in the sighter, only to disappear a moment later, when the airship was sent swiftly in its chase. Its fate apparently created a panic in the remaining group. With one accord they rose in the air. The airship rose with them. Then they veered round, and presently were making out to sea again, the airship following. It caught up one, a laggard, and was almost within striking distance of a second, when by a clever movement the aviator caused his plane to make a spiral, and the flash which the airship emitted had no effect. After his continued success the disappointment of this failure upset Charles's balance. He hesitated for a moment and touched the wrong key. Immediately the airship fell, and ruin was within a hair's-breath when Summers quickly recollected himself, and brought it once again into a vertical position by directing it in a circular course. But the wasted moment had had its effect. It gave the enemy an opportunity to escape, and they were not slow to avail themselves of it. Already the planes had grown so faint in the sighter that they were difficult to locate, and soon they were lost to view. Charles briefly consulted with the commanding officer, and it was agreed that it would be useless to continue the chase further. Therefore he brought the airship back to its hangar, blackened with the heat of the fray and travel-stained with its journey, but none the less ready to act on the defensive again should the necessity recur.

But now it was not the condition of the airship which was to cause any anxiety to the defence authorities. It was the inventor. For on him the final excitement had produced disastrous effects. Already strung up by weeks of anxiety and want of rest, his nerves had reached their breaking point, and the knowledge that so much depended on him had had its due effect. Even while he was manipulating the keys his fingers twitched as though they were uncontrollable, and when his work was done he rose unsteadily from his chair, and complained of a splitting headache. Suddenly he turned giddy, and with a convulsive movement put his hand to his head. Then he clutched at the officer's arm as if to stay himself. With assistance he managed to crawl down the spiral staircase, all the while his knees shaking under him. At first it seemed that these were merely passing effects, due to the recent excitement; but in reality they were ominous signs, presaging trouble to come. The final blow was not long delayed. Laboriously Charles dragged himself to the hangar, and in a dazed condition inspected the vessel to see that all was right. As he bent over the machinery his pale face flushed and his eyes seemed to stare. Then, satisfied that all was as it should be, he drew himself up with a gasp, only to fall with a dull thud on the asphalte beside the machine. Willing hands lifted him up, and he was carried into his room, his right arm hanging helplessly down. It was some time before he recovered consciousness, and then when he attempted to speak he could only utter inarticulate sounds. A doctor was sent for, and at a glance pronounced it to be a paralytic stroke.

CHAPTER XIV.

But it was not a severe attack. A twitching of the eyelids and the working of the muscles in the face showed that nerve power was still active, and that in all probability the patient would ultimately recover. But, as in all such cases, convalescence would naturally be slow, and in the meantime the defences at Caister would be in disorder. The commanding officer, as soon as he received the doctor's report, informed the War Office, and they in turn sent a messenger to personally supervise affairs. It was Sir Harry Dever's idea to go himself as soon as he had the opportunity. In the meantime he sent the news to Braithwaite at Sotheby Vicarage, telling him to inform the relations, but to keep the matter silent to all outsiders. Late that same afternoon he hastened down himself to Caister, and it was well he did, for, arriving there in the afternoon, he found as perplexing a situation as it was possible

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for a man to cope with. Fortunately all the apparatus was intact and ready for use, but there was no one at the station who had picked up sufficient knowledge to manipulate the instrument. Therefore, as far as the actual good the invention could now be as a means of defence, it might just as well not have been organised. It was the officer in charge who suggested a way out of the difficulty. Did Sir Harry know of anyone who could manipulate the machine? If so, it would be well to fetch him, for it looked very much as though the enemy's 'planes would make a fresh attempt to land at night fall. Could he telephone for anybody? No, Sir Harry knew of nobody. Then a bright idea occurred to him. What about Braithwaite? He sent another message to the Vicarage, which was in code, and read: "Can you work wireless airship for Summers?" Fortunately it found Braithwaite in, and he immediately replied in the negative, cursing his luck that he was not able to seize this opportunity to distinguish himself. In the evening he went round to Thrale Hall to communicate the news of Summers's illness to Gwen. The manservant opened the door, and in response to his enquiries told him that Miss Thrale was at home, but was dressing for dinner.

In a minute Gwen came down. Braithwaite turned to greet her, and as he looked at her frank, enquiring gaze, he spoke quickly and evenly, telling her all he knew. He began to comment on Summers's procedure sarcastically. Surely he could have foreseen what was likely to happen if he overworked himself. Why in the name of fortune didn't he have an understudy? There were heaps of men at the works who could have given him a hand.

Then she turned on him.

"I don't think I want to listen to your opinions, Mr. Braithwaite. It's enough to me that Charles is ill, and if you say it is through overwork, that's all the more honour to him. He couldn't foresee that this should happen to him just at the moment when he was wanted most; and as for an understudy, I was his understudy. I know as much about that machine as he does, unless he's altered it very much since I have seen him."

"Oh, yes, Miss Thrale, I know you collaborated with him in the affair, but I thought it was more by your interest than by practical help! Do you understand the working of the machine?"

"Yes, I do."

"Well, then, couldn't you manipulate it?"

"Yes, I could, if, as I said just now, it isn't very much altered."

"Then—you——"

"Yes, I could. I know what you are going to say. Why, of course—at least I can go down to his station and see. Let me go at once. You don't mind?"

Swift as a thought she turned to the bell. The butler appeared. "Tell Foster to get out the Royce car, I shall want to go on a long journey immediately. There is not a moment to lose. He must have it round to the door in five minutes."

She turned to Braithwaite. "Now I will go and see father."

She was not long on her errand, but by the time she came back the car was heard making its way to the door. She came down with a fur cloak and other furs over her arm. Braithwaite helped her to adjust them. Then she entered the car, and told Braithwaite to give his orders. He directed the chauffeur to Caister, adding that it was a matter of great urgency, and they would have to go like the wind, but he would see that they were not interfered with. Then began a journey which neither of them was to forget for the rest of their lives.

CHAPTER XV.

CHECKMATE.

Caister at last. Gwen was only too thankful when the car slowed up in the muddy road that brought them to the gates of the station. Braithwaite stepped out and rang the bell. Sir Harry Dever was there to meet her, and in a few courteous words thanked her for coming, then led her into the officers' study. The usual owner of the room was introduced to her, and he reported on Summers's condition. Everything was satisfactory; the patient had to be kept quiet, but the doctor saw no reason why he should not completely recover, as his general condition was good, and the attack had been brought on only by extraordinary excitement, and was not constitutional. She was asked if she would care to see him, but

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bravely she said "No." How she longed to go to him and give him the comfort of her presence when he was needing it! The knowledge of his proximity made her senses tingle and her heart beat fast, but she was afraid that her visit might unnerve her for the work she had in hand. It would be better to go with her duty fulfilled than empty handed, or with only her love; so instead she asked to be taken to the operator's room in order that she might look over the apparatus, and see whether she could undertake the task of manipulating it. The commanding officer guided her up the narrow staircase to the little room perched like a crow's nest in the high tower. She went up to the operating table. Yes, it was just the same, at least in its main plan; but it was all so much bigger. Before she had played with a toy; now she had to operate a machine of war. She put several questions to the commanding officer, seeking explanations of this or that new part of the apparatus which she could not immediately recognise. He informed her to the best of his ability; but, finding her unsatisfied with his explanations, he sent for the foreman engineer, who had been Summers's chief assistant, and the officer told Gwen to put her questions to him, and this she did, much to the little man's amazement, for, as he remarked afterwards, "He'd never 'a thought in this 'ere world to clap eyes on a lidy who was an engineer, and a purty little bit o' goods too." He found her questions very much to the point, and this filled him with a profound respect. It encouraged him to give adequate explanations, and he was still more surprised to find how quickly the "lidy" in question tumbled to things. The only difficulties were the camera obscura and the sighter. Nothing like them had been constructed at Sotheby, and they were too much of a task for Gwen to understand in a minute or two, but she promised herself to have a shot at it, and see if she could manage to work it; if not, she promised herself she would use the searchlight. Charles had had a searchlight in his own den, and she knew she could work that all right. She saw by the fixtures that there was such an apparatus attached to the tower, and that gave her some confidence. As soon as she had mastered the chief points in the new instrument she asked if she could have the airship out, and immediately the dynamos were set working, and the drone of the engines reverberated in the midnight air. Then, with half a prayer crowding up into her heart, half a dedication of her work to her beloved—she was sure he was her beloved now—she discarded her cloak and sat down at the keys. A moment's hesitancy, then her fingers pulled the lever which sent the airship sliding down the hangars; a second, and it was mounting into the air. She saw it from the look-out and held her breath. It was so enormous—it almost frightened her. Dare she attempt to direct this gigantic fire-fly, this awful craft of war? But she had no time to think. She must try to remember everything that Charles had taught her, and she was a little out of practice. The key to make the machine curve spirally? She looked round bewildered. Ah, there it was. She touched it, and the answering movement of the airship gave her encouragement. Now she must send it out across the sea. Again she was not at fault. 1, 2, 3—those black levers with the white dots, they were the ones, and sure enough the vessel sped on its way, obedient to her will.

A call at the telephone. The little fat man hastened to the receiver. The enemy was upon them, hastening along at a terrific pace with a favouring wind. He shouted the message across to Gwen, and almost the airship tumbled into the abyss of the dark waters, for she was not expecting this. She had almost forgotten that she was taking part in the stern reality of warfare. Now she was brought up sharp with a quick reminder. Again the half-choked prayer made itself heard, but it was no time for praying, only for acting. Nevertheless it gave strength and brought with it a sense of calm—nay, more than that, a cold, icy unreality. She almost felt she could laugh. It was so amusing, this funny little game of war. Then a sigh escaped her—"I can't see it any longer, and I can't make out this light." She sank back in the chair as though she were tired of the game, and would like to give it up. Fortunately the little man was there, and he grasped the situation. "Keep it up, miss," he said; "keep in touch with the hairship and I'll

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get the light on. This 'ere searchlight is good enough to go for a few miles, and I'll work the Johnnie if only you'll only figger the hairship."

It was just the note of encouragement Gwen wanted. She nodded her head, and the fire-fly was sent far out to sea. A moment later and the searchlight fell full on it. She was not a bit surprised when the aeroplanes hove in sight, but she couldn't quite recollect how to get at them. It didn't matter, though; she would remember in a minute. Again the little man came to her rescue.

"There's a plane coming, miss. Get the hairship face on. I'll keep the light full on it. You follow the direction it takes and you'll catch up with it. That there's the knob for the fire-ray, I know. Now. are you ready?" Yes, Gwen was ready: she remembered all about it now. What a chase for a minute or two, but it was a crowded minute of life! A plane dipped and rose and swerved to right and left to get out of the ray of light, but the little fat man was one too many for the aviator. It never escaped, and with every motion it took the airship followed suit. "Work the keys as fast as you can, miss. Get above, then drop in front of it, and you'll do it. A little more, a little higher. Now. The button, quick, miss!" Gwen obeyed. There was a flash of light, the aeroplane flared, then seemed to shrivel, just as a moth shrivels when caught in the flame of a lamp. Like a moth, too, it fell out of the beam of light, and disappeared into the darkness, the nethermost hell. The little man gave a chuckle, but Gwen was not even surprised at her success. It all seemed so natural, just as it ought to be. But the little man's chuckle had stopped half-way. "Look, they're absolutely swarming up now thick as flies," and, sure enough, the aeroplanes were coming in a phalanx upon the airship. "Now, miss, there are three coming abreast. See, they're a-spreading out. We must cop each one. The airship'll work faster now. Don't lose 'em for God's sake!" Gwen wanted no encouragement now. She was thoroughly worked up. All her learning had come back to her, and in a few moments the three vessels, one after another, had sunk beneath the searching death ray. Yet, quick though she had been, two planes had escaped her, flying wide to the south. She attempted to overtake them, but was pulled up by her companion. "Never mind 'em, miss; they will be pulled up all right down there. There's more on 'em coming up from the west. Keep the hairship to 'em." Gwen obeyed, and the airship made an advance to meet them. Oh, it was exciting work! One (a pause), two, and six more of the enemy's soldiery were sent to their account. That decided it. The fleet of planes was disorganised. The great searchlight had picked out the centre body of the force, and the destruction which followed was apparent to all the oncoming planes. Already unnerved by the fate of the first contingent, they were terror-stricken at this unknown foe whom they could not cope with, and who could overreach them and bring death, while they were helpless to resist or escape. Their machine guns were ineffectual to reach her. The instability of their machines made it impossible to take accurate aim, and the swift evolutions of this great war vessel were outside their calculations. They spread themselves out, but to no avail; first one, then another of the fleet was singled out, chased, and picked off. Then it seemed that they were too scattered to effect a landing. Wireless messages were passed between the various units of the fleet, and it was finally decided to give up the attack as hopeless. First one, then another of the planes swerved round and hurried back out of the danger zone, to tell reinforcements that the plan of campaign was a failure, and further advance only meant destruction.

About twenty out of the thirty planes of the main fleet remained. Eight had been irretrievably lost. Two, so it was computed, had escaped by steering northward, and their fate was uncertain. It was a disheartened Council that met on board one of the German steamers in the North Sea, and it was a still more disheartening message that was wirelessed to the main army council in Berlin announcing the ill fate of the expedition and the futility of any further attempt to land on the East Coast. But if the distress of the Germans was great, greater by far was the exultation that filled the little Marconi room. Once again the enemy had been repelled—"and this time by a lidy," as the little fat man said when he nearly wrenched Gwen's arm out of its socket, "An'

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you call yourself a bloomin' amateur! We'd be mighty glad of a few more bloomin' amateurs like yourself at Caister, that we would." He took no credit for his own part in the affair—he was too generous hearted. Gwen smiled and thanked him; but it was a very wan smile, and a very limp hand that he shook. She was exhausted with mental fatigue, and was trembling all over. But there was a quiet light in her eyes; past blunders had been wiped out in the present success.

CHAPTER XVI.

At first Gwen hardly realised the important part she had played in the episode just completed. Everything was too big and her mind could only grasp little things. She was worried about the two planes that had escaped her, and suggested to her companion that they should search for them. He agreed, and the light was sent all over the neighbourhood, without any success. Then he suggested the search should be given up, "for you see, miss," he argued, "if those Johnnies do land they won't be much good by theirselves Some of our men will be sure to snap 'em up." Gwen submitted to his benevolent decision, and brought the airship back to the hangar. Then, when all was completed, she rose from the operating chair, so tired out she could hardly stand, her poor little head a whirl of aches and pains. But she was not allowed to go away in peace. News of the defeat was already abroad. There were steps on the stairs, and the commanding officer appeared, followed by Sir Harry Dever. Following the accepted tradition of the British Army they behaved with becoming composure in the face of success, but there was a triumphant ring in their quiet "Thank you, without your help we were powerless to prevent the landing of this force." Then Sir Harry Dever added, "Now, I should think they will not make a third attempt after they have twice failed, but it is best to be prepared, and if you do not mind remaining we could arrange to put you up here. We will try and make you as comfortable as possible and give you every assistance. Could you do this for us?" Gwen nodded. She was too done up to say anything, and now that immediate anxiety was passed, her only wish was to see Summers. The little fat man was the first to think of it, and he suggested that the "lidy" should be taken down to see "her young man." Brought to a sense of their want of thought, the two officers were sincerely apologetic. Would Miss Thrale like to see Mr. Summers now? He was awake and conscious, but had to be kept very quiet. The doctor had been asked if the patient could see any friends; he had given his consent, but any visits were to be of the shortest possible duration, and Mr. Summers was not to be allowed to speak. Thereupon they led the way down the iron staircase. The sight of the invalid gave Gwen a shock. She could not realise that this was Charles, the long, gaunt active man she had always known who had seemed impervious to fatigue and illness. She leaned forward forgetful of the nurse, and knelt by the bedside, picking up the hand which lay on the bedclothes, and kissing it. But she only knelt a moment, then, standing up, she stooped over him and gave him one long kiss on the forehead, such as she had never given him before. She forced herself to smile, then returned as quickly as she came in, not daring to look back as she went out of the room.

. . . .

For several weeks Gwen remained at Caister in case of emergencies, but no enemy appeared, and as the commander of the station put it, "It looked as though the Germans had had a sufficient drubbing to teach them manners." Some time after his opinion was confirmed by the report that the strange vessels and submarines that had been located far out in the North Sea had disappeared, and it was believed they had managed to get through the line of the British fleet off the Baltic, for no trace of them could be found. The airships, too, had disappeared into oblivion, though a good many could be seen reconnoitring off the German coast, though they never got within reach of the British guns. As to the two stray airships, they had been accounted for. One landed at Kirby Moorside, and the other not far from Galashiels. They were both easily overcome, and the passengers realising the uselessness of resistance, surrendered to unkindly fate. All this time Charles had been making rapid progress towards recovery. A masseur had been called in, and now he had full con-

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trol of his limbs, though he was weak and shaken. Charles's exploits and her own had been blazoned abroad in the papers, and the romance attached to them stirred up the sentimentality of the English public, as it always is stirred by romance. Charles Summers's name was on the lips of the man in the street, and that meant fame. But it was not fame of an ephemeral description, for his work was of a lasting quality and likely to outstand the breeze of popular favour. It stood for a revolution in military aviation, and the fact that it had been authorised by the Government gave it sufficient prestige to awaken the interests of the chief scientists of the kingdom. One and all acknowledged the genius of the inventor, and many were the schemes suggested for his reward.

. . . . .

Caister had become a dream. Charles had been back to Sotheby Vicarage, and he, his father and sister, and Gwen, were now at Bournemouth tasting to the full the benefit of the soft spring air, and delighting in the transformation of the land from winter to summer.

One day as the two were sitting together watching the sea curling tremulously blue beneath the cliff, Gwen broke the silence with a sigh, then turning towards her lover, she put her hands in his.

"Charles," she said, "I have something to tell you," and she told him the story of Braithwaite's infatuation for her. She paused as she ended, but Charles said nothing, only looked down at her and smiled, the same old smile that she had learnt to love and wait for. That gave her encouragement, and she added: "I can see it all now, dearest. I can see what a silly little fool I was, but then I was so much younger. Life had never taught me any of its real lessons. I can see how wayward and foolish and perverse I was. I thought I knew everything, and I knew nothing at all. Those foreigners wanted your invention, and they got it through me, and Braithwaite wanted his own success and hoped to get it through me. I was the pawn in the game, and the stakes were love and honour. Thank God they got neither." Charles looked at her and smiled, then he lifted the little hand and kissed it.

"Gwen," he said, "you did more for me than I could have done for myself, and, my beloved, I didn't deserve it. If you were wrong I was doubly wrong, for my love was selfish and self-centred. I was patronising and magnanimous. I treated you as a child when it was your due to be treated as a woman. I, too, did not see it then, but I too have learnt a lot. Once I thought that all my work was being done for you, now I can confess that it was for my own pleasure, and you hardly came into it at all. But I want you to forgive me for my unworthiness, forgive and forget. You can afford to be generous, Gwen, for all that I am or am likely to be is your doing; you have given it me, every bit. Let's cry quits and begin afresh. Teach me to love you as a man and not a scientist."

Gwen looked up at him, and her eyes were full of tears. She took his face between her hands and gave him a long sweet kiss, such a sympathetic kiss as only those who have failed and tried again and won know how to give. Then there was silence when heaven touches very close to earth. At last Charles drew Gwen nearer towards him.

"Come closer, Gwen," he said, "come closer, for the pawn in the game won me my queen." [THE END.]

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Atlantic Coast Chain

New Station at Miami.

WHILE appeals are being made for the subscription of large sums to celebrate the century of peace between England and America, which has just been completed, the work of cementing the friendship of the two nations is being silently carried on by other powers besides ambassadors and International Committees. Industrial development, which makes no announcement from the housetops, has been one of the most potent factors in the cause of peace, for one of the chief lessons that commerce has to teach is the fact that the nations must stand shoulder to shoulder if mutual prosperity is to be advanced at all. But commerce needs a voice and ears if her operations are to be effective, and only adequate means of communication can supply this necessity. In the last century such possibilities have been developed enormously, and now with the establishment of wireless telegraphy it seems that commerce is well provided with resources. But such is the use made of this service that it is continually necessary to build always larger and more powerful stations. That at Miami is the latest addition to the service, and when it is opened, as is expected it will be very shortly, it will be one of the most important commercial wireless telegraph stations in the United States. Miami is in Florida, and is situated at the mouth of the river which gives it its name, and has steamship connection with Havana, Nassau and San Juan. The station will thus break up a long stretch between Jacksonville and Key West, thereby greatly facilitating the handling of messages, besides controlling much of the business which now passes through the Government station at Key West. By establishing communication with the Nassau station it should be able to supplement the ship and shore business.

Miami. The pavilion in which the Wireless set will be erected.

Active work on the new station was commenced by the Marconi Wireless Telegraph Company of America at the beginning of this year, and the accompanying illustrations are reproductions of photographs taken before building operations commenced. The wireless set is being installed in the pavilion which is being adapted for the purpose, and the towers will be erected near the end of the bridge shown in the second illustration. A 5 kw. set is being installed.

General view of the Miami Site, the towers to be built near the bridge.

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Contract News

Marconi's Wireless Telegraph Company of America have received orders from the North Pacific Steamship Company to install a wireless apparatus on board their steamer *Cetriana*. The call letters will be M O B.

* * *

In last month's issue of the WIRELESS WORLD, six steamers, the *Thessaloniki*, *Frederik VIII.*, *Bolama*, *Loanda*, *Funchal*, and *Sitges* were notified as having been fitted with wireless by the Debeg Co.; they should have been inserted under the list of ships fitted by the Société Anonyme Internationale de Télégraphie sans Fil, of Brussels.

The S.A.I.T. have this month equipped the following Vessels :—

Name of Vessel.	Owners.	Type of Installation.	Call Letters.
Commonwealth	Chr. Nielsen	Coil sets	—
Karrakatta	,,	,,	—
Kelm	,,	,,	—
Francoli	Tintore	½ kw.	EFF
Guine	E.N.N.	½ kw. and emergency set	CSG
Noordwijk	Erhardt and Dekkers	,, ,, ,,	PHG

Orders have been received by the Marconi International Marine Communication Company to equip the following Vessels :—

Name of Vessel.	Owners.	Type of Installation.	Call Letters.
Great City	Great City Steamship Co., Ltd.	1½ kw. and emergency set	MKW
Mexico	La Cia Mexicana di Navegaçao S.A.	,, ,, ,,	XBB
Tokomaru	Shaw, Savill and Albion Co., Ltd.	1½ kw.	MNF
Minnie de Larrinaga	Larrinaga and Co.	,,	MLA
Indus	J. Nourse, Ltd.	½ kw. and emergency set	MCR
Mutlah	,,	,, ,, ,,	MDA

The following Vessels have been equipped with Marconi Apparatus since the last issue of this Magazine :—

Name of Vessel.	Owners.	Type of Installation	Call Letters.
Massilia	The Anchor Line	1½ kw. and emergency set	MHQ
Olympia	,, ,,	,, ,, ,,	MHI
Nonsuch	Messrs. G. Yuill & Co.	,, ,, ,,	MYH
San Jeronimo	The Eagle Oil Transport Co.	,, ,, ,,	MJP
San Lorenzo	,, ,, ,,	,, ,, ,,	MND
San Ricardo	,, ,, ,,	,, ,, ,,	MBR
Carnarvonshire	The Royal Mail Steam Packet Co.	,, ,, ,,	MZR
Palma	The Peninsular and Orient Line	,, ,, ,,	MKD
Broadstone	The Blue Star Line	,, ,, ,,	MIS
Missouri	The Atlantic Transport Line	,, ,, ,,	MLD
Colorado	The Wilson Line	,, ,, ,,	MMS
Baron Napier	H. Hogarth & Son	,, ,, ,,	MJS
Orduna	The Peninsular Steam Navigation Co.	,, ,, ,,	MGP
Architect	T. and J. Harrison	,, ,, ,,	GYO
Highland Laird	Nelson Line	,, ,, ,,	MEP
Eupion	The Pierce Oil Corporation	½ kw. and emergency set	MKT
Roebuck	The Great Western Railway Co.	,, ,, ,,	—
Pardo	The Royal Mail Steam Packet Co.	,, ,, ,, (refitted)	GLL

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Practical Hints for Amateurs

My Wireless Station

By M. F. GANTLY *

PERHAPS the following notes on my wireless receiving station may be of interest to some enthusiasts. It is rather discouraging to the wireless aspirant to hear so many comments regarding the height of the aerial. Well, of course, the higher the better, but with a height of 34 ft. I have gained results which exceeded my most sanguine expectations.

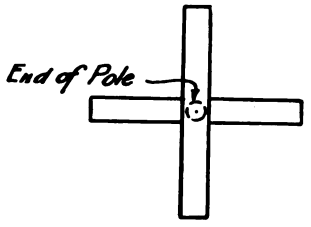


Fig. 1

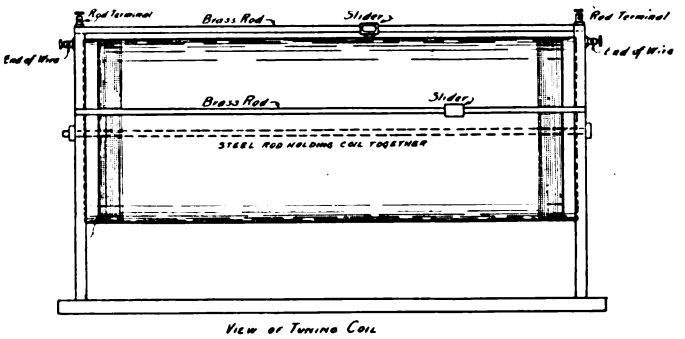
I obtained two scaffolding poles, 38 and 34 ft. high. The holes in which they are buried are 4 ft. deep. On the end of the poles are fixed two crossboards, about 4 ft. long (Fig. 1). These tend to keep the poles steady in the ground. The poles were given a good coat of tar. They stand 34 and 30 ft. above the ground, and are 70 ft. apart. A few wire stays are sufficient to keep them in position. The aerial is a two-wire one, the wires spaced 6 ft. apart. The lead-in is taken from the highest end, which is the farthest from the instruments. It was originally taken from the nearest and lowest end, but the latter arrangement is far better.

The earth consists of a plate of lead, 2 ft. by 1 ft., and a plate of corrugated iron, 4 ft. by 4 ft. These are buried at a depth of 5 ft., separated by coke, and are surrounded by coke also. The earth wire is a thick copper one. It is soldered on to each plate and the joint covered with pitch to prevent the action of the earth from taking effect on the solder.

The receiving instruments are a two-slider tuning coil, detector, fixed condenser, variable condenser, and phones. With the exception of the latter they are home-made.

The tuning coil is made as follows:—A cylindrical cardboard roller, 14 in. long by 5½ in. diameter, and well coated with shellac varnish. When dry, I wound about 300 turns No. 22 enamelled copper wire on it, taking care that each turn was spaced from the next. I then cut two end-pieces and made a circular groove in each to hold the ends of the coil, which were also coated with shellac. The coil was fitted together with a steel rod passing through the end-pieces and coil and clamped with a nut. It was then given two coats of shellac, and when dry the insulation was scraped off where contact was desired. Two brass rods, fitted with terminals, were fitted to the end-pieces for the sliding contacts. The sliders used were of the ball contact type.

The detector is simple in construction and is of the crystal type. It is made from old scrap brass and bicycle nuts—rather



View of Tuning Coil
Fig 2

* See our comment on page 771.

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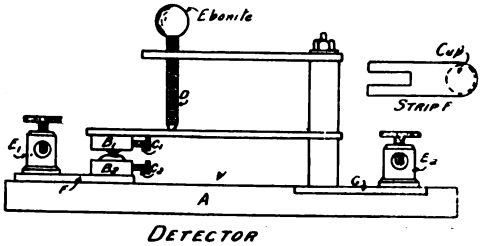
crude materials, no doubt, but efficient. Its construction is shown in Fig. 3.

A is a hardwood base which has been steeped in paraffin wax; B1, B2, are the



DETECTOR
Fig 3.

two cups for holding the crystals, and are made of bicycle valve nuts. They are fitted with screws, C1, C2, which hold the crystals in position. This makes it easy to adjust the crystals and fit new ones when

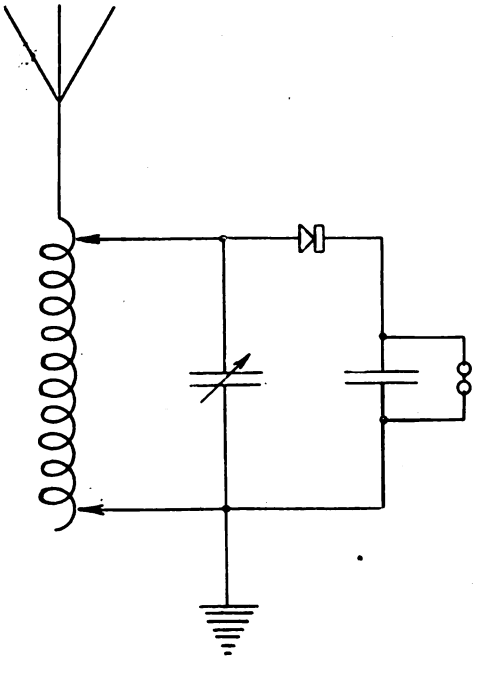


Fig 4

the old crystals become insensitive. It is just as efficient as using Woods metal and much more simple. I find that zincite and copper pyrites are the best crystals to use. The screw, D, allows of the contact of the crystals being varied. It is fitted with an ebonite head. The part, F, is cut as shown in Fig. 3. This allows it to slide under the terminal E1. The terminal E2 and the stand are connected by the brass strip, G.

The fixed condenser consists of four sheets of tinfoil, 5 in. by 4 in., and five sheets of paraffined paper 4½ in. by 4½ in. The tinfoil is cut with a tab at the end of each sheet. The sheets of tinfoil are placed alternately with the paraffined paper, in such a way

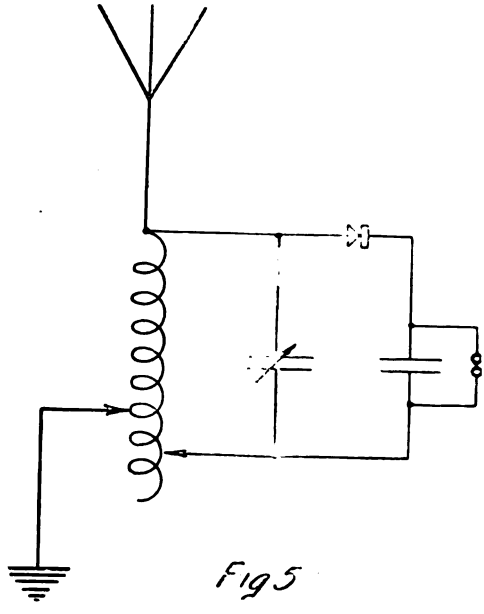


Fig 5

that the tab of the second sheet is on the opposite side to the first, and so on. A terminal is then passed through the tabs at each end and through a cigar box (or anything else suitable), and the condenser is complete.

The variable condenser is made of ten glass plates (old photo plates, with film thoroughly cleaned off, are admirable for the purpose), 8½ in. by 6½ in., five sheets of tinfoil, 6½ in. by 4½ in., and five strips of copper foil, 4 in. by 1 in. One of the strips of copperfoil is stuck with shellac on each of five of the glass plates, leaving about an inch projecting beyond the edge. Over these are stuck the tinfoil sheets in the centres of the plates, thus leaving an inch margin all round. The tin and copper foils must make perfect contact. The glass margin is now given a coat of shellac, and one of the plain glass plates is stuck over each, thus forming a tinfoil "sandwich."

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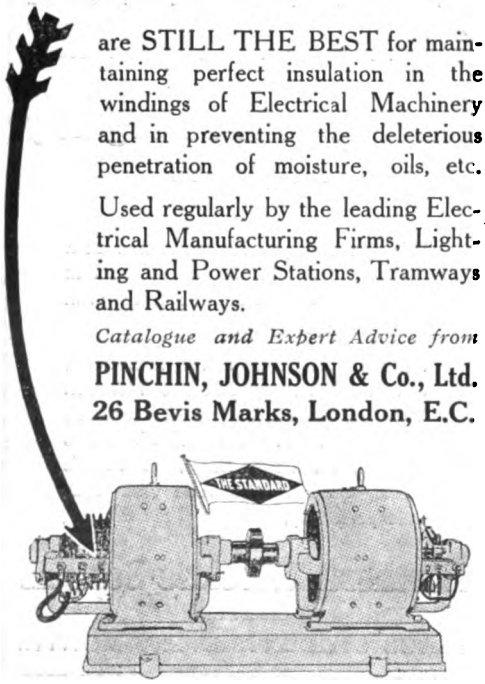

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Eight pieces of cardboard are now prepared and immersed in shellac. These strips hold the "sandwiches" together and form four spaces to admit of the movable zinc plates. A stand is made to hold the glass plates. The copperfoil tabs are clamped by a terminal to a piece of ebonite fitted into the stand for the purpose. Four zinc plates are clamped together on a brass rod, with a washer separating each plate to allow them to slip easily between the glass plates. The variable condenser is made in accordance with the description which Mr. F. G. Perkins published some time ago.

I have found that the variable condenser is useful with long wave lengths, as it greatly increases the strength of the signals.

The connections were originally as shown in Fig. 4, but I found that with the arrangement shown in Fig. 5 I was able to get ships very loudly. I can hear Liverpool, Crookhaven, and many of the ships without using a variable condenser at all, but connected as Fig. 6.

By connecting the aerial and earth direct to phones through the detector, without

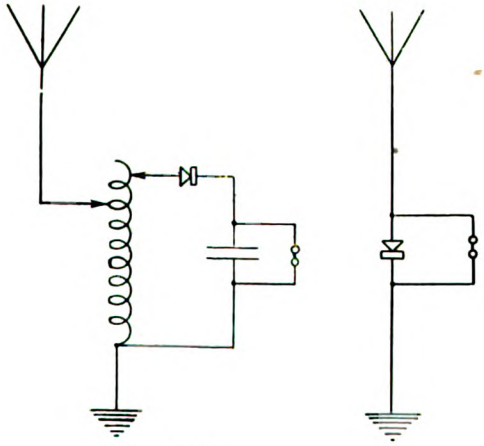

Fig. 6

using anything else, I can get Clifden very loud and can also get Poldhu.

This is a simpler method of reading Clifden than by using a loose coupler. It seems to be an understood thing with many wireless enthusiasts that you need a big aerial, loose coupler, and other rather expensive apparatus to get Clifden. Well, I get the station working, either day or night, with the detector as described. Two of my friends who are also interested in wireless get Clifden in the same way.

Mr. Gantly's Wireless Set.

With this simple set it is possible to read Poldhu with a fine, steady note, sending out press. It is possible to hear the operator in the Eiffel Tower, Paris, tapping out his time signals in a deep base note and to read the high-pitched piping note of Norddeich or the clear even one of Clifden sending "LCO's" over the Atlantic to Glace Bay. The signals sent by a liner ploughing her way through the deep are clearly heard, as is Cleethorpes sending out weather reports in a quick, rather peculiar note.

It is interesting to listen to the large ships in mid-ocean exchanging signals with each other when miles apart, just as though they were berthed alongside.

In fact, it is only when listening to this, and pondering over it, that one realises the marvels of wireless telegraphy, the priceless boon for which the world owes its gratitude to the brilliant genius of its great inventor, Mr. Marconi.

AMATEUR NOTES.

MR. GANTLY, whose article dealing with his station we publish on page 769 of this number, asks us if anyone else "gets Clifden" with the circuit described by him. We admit we were surprised to learn that he succeeded in receiving Clifden with such a very incorrect circuit, but were relieved to see from the address

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on his notepaper that he lives in Co. Tipperary, and is not, therefore, very far from the great station. He asks also for an explanation of the fact that with his receiver he finds signals very faint for a time, and then a slight "click" comes and signals get all right. This looks to us like a coherer-effect (or the effect of some other kind of imperfect contact), and probably lies in the crystal-contact itself. Possibly an atmospheric comes along and breaks down a thin film of oxide, after which all goes well.

* * *

In a recent number of THE WIRELESS WORLD we published some correspondence between Mr. Hope-Jones and the Secretary of the General Post Office, regarding the proposal of the Postmaster-General to levy a tax or royalty on those who desire to use wireless receiving sets for listening to the International Service of Time Signals which now cover half the surface of the globe, and are easily picked up in England, from the Eiffel Tower, Paris, and Norddeich, Wilhelmshaven. The Secretary to the Post Office now announces the abandonment of this intention in a letter to Mr. Hope-Jones, dated February 5th, of which the following is a copy:

"With further reference to your letter of December 16th last and previous correspondence on the subject of the issue of licences for the reception of Time Signals by Wireless Telegraphy, I am directed by the Postmaster-General to express his regret that it has not been possible to send you a definite reply at an earlier date, and to inform you that, in view of the representations made by you and others, he has decided not to require payment of an annual royalty for licences issued in respect of apparatus intended for this purpose. The fee of £1 1s., which is charged to cover the Office expenses connected with the issue of the licence and the inspection of the installation, will, however, still be payable by applicants for such licences. "(Signed) E. CRABB.

"On behalf of the Secretary, P.O."

* * *

We were only able to refer briefly in our last issue to the inaugural meeting of the Wireless Society of London on January 21st, which, from every point of view, was an unqualified success. Never have we seen the large lecture theatre of the Institution so crowded by a gathering which followed the proceedings with the closest interest and manifested by its applause its sense of appreciation of the successful demonstration of the ways by which signals coming from Eiffel Tower and elsewhere could be made visible and audible.

* * *

An aerial was erected on the roof, and arrangements were made to receive a message from the Eiffel Tower. This was received on a syphon recorder, and the movements of the pen marking the strip were clearly shown on the screen by the use of a Lietz Universal Projector. For working the syphon recorder three of the relays designed by Mr. S. G. Brown were used. One of the "A" type instruments was connected to the oscillation transformer. This fed a telephone "G" type relay, to which a telephone was connected, and lastly this was coupled to a "W" type relay. This relay is so adjusted in use that the contact is broken by the very small quick movements of its rocker. The movements are too quick for the syphon recorder to follow, but the duration of each group, however, is recorded. Among the other detectors may be mentioned the sensitive manometric flame, which is influenced by feeble sounds from the receiving telephone, or the gas issuing from a very fine jet may be passed through a piece of wire gauze and lighted. This flame is more rapid in action and therefore more dead-beat. The most sensitive spot for the telephone is at the mouth of the orifice from which the jet issues. These instruments may be tuned to discriminate between sounds of different acoustic pitch. Besides the Brown relays, the Heurtley relay may be used. In this a moving coil moves a very fine straight wire of considerable resistance, which is slightly heated by passing a current through it, in and out of a blast of cold air proceeding out of a narrow slot. The alterations in resistance due to the temperature changes are sufficient to work a telegraphic instrument. In the Orling relay a suspended coil has a finger which just touches on one side of a minute jet of acidulated water. When the coil moves the jet is moved to a much greater extent, and is arranged to bridge or leave open the space between two contacts in a local circuit

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Mr. Swinton compared the sensitiveness of electrical detectors with that natural detector of electromagnetic waves—the human eye. The light from a 12 candle-power lamp on a perfectly dark and very clear night can be seen at a distance of about five miles, the amount of energy radiated as visible light in all directions being about one watt. Assuming that the aperture of the eye of the observer under such conditions is one-fifth of a square inch, then the proportion of the one watt radiated that reaches the retina is the proportion that the area of a circle one-fifth of an inch bears to the superficial area of a sphere the radius of which is five miles. This gives the amount of power that reaches the retina as about one-sixth of one-billionth of the one watt radiated; so it would appear that the sensitiveness of artificial and natural detectors of electromagnetic waves are of the same order. For instantaneous effects both these artificial and natural detectors of electromagnetic waves are vastly more sensitive than any photographic process, though, owing to the cumulative nature of photographic action, things can be photographed by means of prolonged exposures that the human eye or our most delicate electrical instruments would not in any way be able to detect. This is, of course, taken advantage of in many cases, as, for instance, in astronomy.

* * *

Lord Rayleigh, some years ago, found that the human eye and ear were of the same order of sensitiveness; and how very sensitive the human ear is to the most minute sounds is shown by the fact that Mr. Swinton has been able to hear the Eiffel Tower with his very small aerial and a single relay upon a hot-wire telephone. This instrument, which was invented by the late Sir William Preece many years ago, consists simply of a short length of very fine wire attached to a diaphragm. The current is passed through the wire and, owing to its expansion and contraction, causes the diaphragm to vibrate. In his case, he has taken the inside out of an ordinary Bell receiver, put in a mica diaphragm, and stretched between this and a little device for altering the tension a tungsten wire only fifteen microns in diameter; in fact, a piece of lamp filament. It is obvious that with electric currents of the magnitude with which we are dealing changes in the temperature of the wire caused by the signals must be a very small fraction of a degree, and consequently the elongation and contraction of the wire must be almost inappreciable, yet the diaphragm vibrates sufficiently for the signals to be clearly detected by the ear.

* * *

With regard to the future of wireless telegraphy, using the latter word in its Post Office sense, which includes telephony, Mr. Swinton supposed that no one thought otherwise than that wireless was in its infancy, to use a stock expression that it used to be the fashion to apply to electricity. Wireless telephones, he supposed, were sure to come before long. The chief difficulty at present was to get a telephone transmitter or microphone that would carry sufficient current without burning up, or, at any rate, becoming overheated. Multiple transmitters, water cooling, and even transmitters on the Chichester-bell principle, in which the current is caused to vary with speech by applying the articulate vibrations to a water jet, had all been employed, but with none of them could more than a few kilowatts be dealt with. Another difficulty was that changing over from sending to receiving or *vice versa* required the operation of switches, which rendered ordinary conversation somewhat troublesome. These were, however, difficulties that ought to be got over in time. While wire telegraphy and telephony were particularly fitted to send messages to particular places and to reach particular individuals, wireless seemed by its nature to be suited for the universal distribution of intelligence, weather reports, time signals, or speeches. Indeed, with a little imagination, one could picture to oneself in the not very distant future wireless receiving stations specially set up in connection with halls resembling picture palaces, where people would be able to go and hear *viva voce* all the prominent speakers of the day, although these might be speaking hundreds of miles away. Again, why, with improved apparatus requiring less attention and adjustment than what we at present use, should not a wirelessly operated column printing telegraph in every house tell the latest news to all the nation, as also to the

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newspapers, should any of these continue to survive this much more rapid method of disseminating intelligence ?

* * *

One thing seemed pretty certain, that if we were ever to have transatlantic telephony, it would be wireless, as on this system all the difficulties due to capacity and self-induction of the cables were avoided, and it is these that rendered long-distance submarine telephony impossible at the present time.

* * *

The following is a translation of the copy of the message which was received from Commandant Ferrié ; it was transmitted in French :

" Commandant Ferrié sends to the worthy President and to his esteemed fellow-members of the Wireless Society of London his heartiest greetings and the assurance of his cordial goodwill. Long live England ! and long live the *Entente Cordiale* ! "

* * *

The following reply was sent :

" The President, Committee and Members of the Wireless Society of London thank Commandant Ferrié very sincerely for his expression of goodwill to the Society, and reciprocate it most heartily.

" Long live France and the *Entente Cordiale* ! "

* * *

At the January meeting of the Dublin Wireless Club, Mr. P. K. Turner delivered an interesting address on the use of detectors in wireless telegraphy. He divided detectors into the following three classes, viz. : coherers, magnetic and crystal. Mr. Turner explained the theory of the magnetic detector, paying special attention to the phenomenon of hysteresis. The valve and electrolytic detectors were treated at some length, and excellent analogies were given, which made the principles more easy to understand. Woolaston's ingenious invention for drawing platinum wire out to a minute portion of an inch was also touched upon. All through the lecture Mr. Turner took great trouble in his explanations, making them obvious to the beginner, and illustrating by diagrams of connections each section dealt with.

* * *

A General Meeting of the Club was held on February 5th. Mr. G. E. P. Marshall was unanimously elected to the office of President, vacated by Dr. Spencer Sheill, who, through the increasing demands made on his time by professional duties, found that he could not attend the meetings of the Club as he felt the President should. Resulting from the report of the sub-committee appointed to go into the matter of obtaining more central premises, the offer of the use of rooms and apparatus for one evening per week at a nominal rental, made by Mr. P. K. Turner (proprietor of the Dublin School of Wireless) was accepted ; and to fit in with Mr. Turner's kind offer, the night of the Weekly Meeting of the Club was changed from Thursday to Wednesday. It was decided that the members should meet at the new premises, 11, Lower Sackville Street, on the first and third Wednesdays in the month, and on other Wednesdays at the Club Headquarters, St. Pancras, Harold's Cross Road, Terenure. Mr. H. J. Duncan was elected Treasurer. Intending members are invited to send in their names to the Honorary Secretary, Mr. F. Dixon, 21, Ashdale Road, Terenure, Dublin.

* * *

A meeting of the Northampton and District Wireless Club was held in the new club room, at the " Garibaldi," Ash Street, on January 28th. The President, Mr. F. H. Wright, was in the chair. A communication was read from Le Commandant Ferrié. Mr. E. H. Coleman having been appointed to an important position with a Birmingham engineering firm, resigned his position as Secretary, and a vote of thanks was accorded him for the work he had done. Mr. A. E. Farmer was elected Secretary in his place. The erection of the Club station was then discussed, the matter being left in the hands of the Committee. Mr. T. Hancock then displayed his portable receiving set, giving particulars of experiments he had carried out with kite aerials and various earths. The Secretary's address is 7, Aberdeen Terrace, St. James's, Northampton.

* * *

A well-attended meeting of the Birmingham Wireless Association was held at the Club-room, John Bright Street, on Wednesday, February 4th, which was addressed by Mr. H. von Kramer. The chair was occupied by Mr. W. F. B. Bartram. Mr. von Kramer's subject of address was

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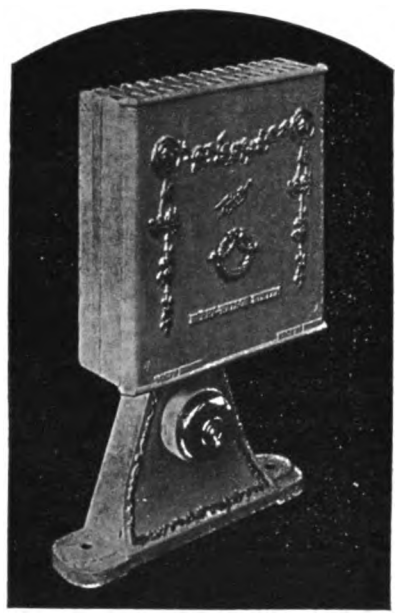

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the "Railophone and the K.K. Detector." He laid great stress on the fundamental laws of electricity, particularly with regard to induction, and then described some of his experiments with inductive circuits, the result of which has been the introduction of the Railophone system, for the automatic prevention of collisions on railways, by bringing any train to a standstill which endeavours to pass a home signal at danger.

* * *

At the annual meeting of the Liverpool Amateur Wireless Association it was reported that satisfactory progress had been made during the past year. Mr. J. T. Mathews, Chairman, Mr. J. R. Forshaw, Vice-Chairman, Mr. S. Frith, Hon. Secretary and Treasurer, and Mr. Wilde, Assistant Secretary. A committee comprising the following gentlemen was elected: Messrs. J. A. Henderson, N. D. B. Hyde, G. Irvine, J. Bolton, W. H. Constable Kew, and J. Coulton. The question of renting a permanent club-room was discussed, and Mr. F. Shaw called attention to the complaints of interference received from the Seaforth Station. It was agreed that the members of the Club should use their best efforts to suppress this nuisance.

* * *

A meeting of the Liverpool and District Amateur Wireless Association was held on February 10th, with Mr. J. T. Matthews in the chair. Several new members were elected, and it was announced that Mr. F. Shaw had consented to become president for the current year.

* * *

A report was presented regarding the negotiations for the new club-room, and a motion was carried that the tenancy of the proposed room should be entered into. It was also arranged for a detail list of members' stations to be compiled and printed in conjunction with the club rules. One member reported results of experiments with an inside aerial: total length 15 feet long, 30 feet lead to instruments, and is said to have heard Marseilles, Orient and other French stations, as well as English coast stations. Another member gave a report on his observations on atmospherics. There were also elementary and advanced Morse code practice.

The Barnsley Amateur Wireless Association held a successful general meeting on January 21st. The special wireless message which was sent from the Eiffel Tower, Paris, to the Wireless Society of London during their meeting held on the same evening was received simultaneously at the headquarters of the Barnsley Wireless Association.

* * *

The Cheshire Radiographic and Scientific Society has lately adopted a new title and is now known as the Radio-Scientific Society. A smoking concert inaugurating the society under its new title was held on January 21st at Manchester, with the further objective of bringing all the members together for a discussion on the future policy of the society and for the arrangement of a comprehensive programme for future meetings. Under the able chairmanship of Mr. J. R. Halliwell all these matters were satisfactorily dealt with. The meeting concluded with an admirable entertainment of varied character. Particular mention should be made of a remarkable selection of phonograph "music" given by one member of the society, who reproduced "in linkèd sweetness" signals from the wireless stations at Paris, Seaforth, and Liverpool, which were recorded on an instrument of his own invention. Later, the same member reproduced musical records by means of his improved sound-box.

* * *

Meetings of the society are held each Wednesday evening at the "City" School of Wireless Telegraphy, 43, Thomas Street, Manchester, and all desirous of joining are invited to come to the meetings or communicate with the Honorary Secretary, R. J. Thompson, Southbank, Broad Road, Sale, near Manchester. The subscription is 5s. per annum. The society has now more than 60 members and is still steadily growing. A portion of each meeting is devoted to "Code" practice, and a course of short lectures on "Electricity as Applied to Wireless Telegraphy," by Mr. J. R. Halliwell, is proving of great assistance to members. In addition to the above, a special subject is given at each meeting, followed by a general discussion. A lantern is now at the service of lecturers who wish to illustrate their papers by means of slides.

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QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

J. M. N. (Manchester).—We fear that your experiment is merely a step in the backward direction, leading to inductive "wireless" as used in pre-Marconi days.

E. B. (Louvain).—(1) We cannot give any opinion as to the novelty of an invention; we think the arrangement you propose would work, the drawback being that the inertia of the diaphragm might be rather great. (2) Tissot's value is the nearest.

S. G. (Kingstown) is a young beginner, and writes to ask us several questions. He very politely adds that if they are too much trouble to us to answer, we are not to bother about them. It is not the trouble which we cannot spare, but the space. We think that a careful study of our Amateur articles, our instructional articles, and our Questions and Answers columns will give him most of the information he requires. In a few words we may give the following hints: No. 22 is a good wire for a direct coupled inductance for short waves, but if he intends to receive the big stations this wire would take up too much room, and he should use No. 26 or 28. Enamelled wire is convenient. For the crystal, carborundum with battery and potentiometer, or zincite-bornite without. As high and long an aerial as possible. For small light aerials No. 18 copper or silicon-bronze is good.

J. P. H. (Fleetwood).—Your aerial seems all right as it stands. On the right of your sketch you show a straight vertical line marked "44 ft. from ground"; we do not know whether this represents another building, or merely a height. If it is the wall of a building, it is possible that you are being rather badly shielded by this. You do not say what stations you have been trying to receive; if you are looking for ships, we should say that your secondary circuit was tuned to far too long a wave; for even on the shorter stops you have all the self-capacity of the unused portion adding itself on to the capacity of your condenser across the secondary. By the way, you do not mention what that capacity is; that alone may be too big for ship-waves. Do not forget that for any waves, using a high-resistance detector you want *large* inductance and *small* capacity in your secondary circuit. If you are trying for waves of 2,000 metres or so, we think your apparatus is well-adapted to them (though even here we are handicapped by lack of data) and can only suggest that the circuits are not properly tuned. For long waves you might try, as a preliminary, connecting your detector direct to the top of the tuning inductance of the aerial-circuit, thus cutting out the coupled circuit.

A. C. (New Brighton) has a one-slide tuning-coil, which he puts in series with a two-tappings coil; he puts the aerial on to one end of this combination, and then leads the other end to earth through his silicon-platinum detector, across which he shunts a pair of phones, 100 ohms each, and connected in parallel. He is altogether wrong: he has got a high-resistance crystal in series with his oscillating aerial circuit; not only that, but the crystal is situated at the point of lowest potential instead of highest; and he is using telephones which are not in the least suited to "wireless" unless used in conjunction with a telephone transformer. He should buy all the back numbers of THE WIRELESS WORLD and read all the Questions and Answers dealing with telephones and telephone transformers; all our instructional articles, and, above all, our reply to W. E. D. in the February, 1914, number.

E. J. F. (Woolwich).—(1) Yes. (2) Best to mount car borundum in brass cup with Wood's metal or soft solder, point pressing against steel spring. But it is not *necessary* to have any cup at all, the crystal being held between two springs. (3) The wires will probably affect your receiving to some small extent but we do not think your proposed change would be of any benefit. (4) Yes, for receiving.

N. E. J. M. (Watford) proposes to erect a receiving station, and asks us what the normal day-and-night range would be, and if it would be capable of receiving from Barcelona, Cadiz, Lisbon, Aranjuez, Vigo, Stavanger, Coltano, Bergen, Dantzig, Copenhagen, and Gothenburg. In reply to such a comprehensive query as this we really can only reply "Wait and See." We have said over and over again that there is no such thing as an intrinsic "normal range"; too much depends on the nature of the surroundings, skill of erection of aerials and earths, the design of the apparatus, the crystals used, and, above all, the technical skill of the experimenter in adjusting his instruments properly.

A. D. (Glasgow) is puzzled by the fact that when resistance is put into the field of a motor the latter speeds up. He also wants to know how the power—and, therefore, the range—of a station using a rotary-converter to produce the condenser-charging current is increased; he has tried to increase the a.c. voltage and amperage by speeding up the converter, but finds that this has no effect. If he reads Hawkhead's "Handbook" he will find most of his difficulties vanish. The effective a.c. voltage of a converter is a definite fraction—0·745—of the d.c. voltage which drives the machine; and, therefore, speeding up the latter has no effect on the a.c. voltage, except in so far as it may pull down the driving voltage. A. D. is using a higher voltage to drive the machine than the normal; he is in fact using 250 volts instead of from 70 to 110 volts; and he asks if this accounts for the power being over 1½ kw. Probably he means that by multiplying the a.c. volts and amperes together he gets a value of more than 1½ kw. The "Handkook" explains that this does not necessarily mean that he is getting more than 1½ kw. of actual power. He also asks a question as to his aerials; if the angle which his down-lead makes with the horizontal part is not too sharp for receiving work (as he says) it is not too sharp for transmitting either. But we do not feel quite satisfied that he is justified in saying that it is not too sharp for receiving. He should certainly try a comparison of the two cases for himself, measuring the strength of received signals in either case.

F. L. (Oxfordshire Boy Scouts).—At the end of your last letter you ask "Does the fact that our gear is in an iron building make any difference?" This might easily be enough to cause all your troubles; if your aerials, either for sending or receiving, are near the iron walls of a building, you will lose a very large proportion of the energy. Make your preliminary tests, at any rate, right in the open; and make sure that you have good earths at either end; if you cannot bury metal plates, then use wire-netting or run a number of wires out along the surface of the ground.

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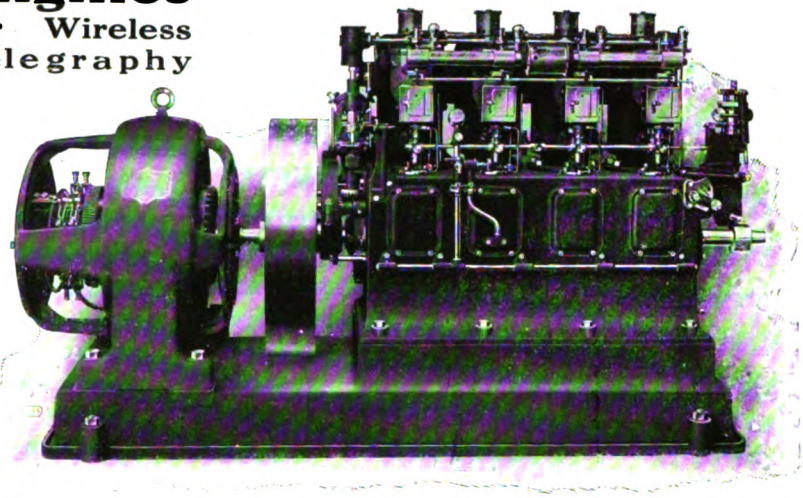

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M. G. R. (Woolford).—With regard to the planning of your aerial, we are inclined to think that the best plan would be for you to erect three separate "twin-wire" or "hoop" aerials radiating from a mast attached to chimney F to the three corners, A, D, and C, leading in from all three through the window, E. The wires would not reach right to the three corners, but would have such lengths of small rope attached to their end-spreaders as to keep these latter at a good height from the ground. These ropes would be made fast in the three corners, and in order to make them pass at a convenient height above the bowling-green, etc., you might put in a short mast at each place; the guys for these masts would be so short that they need not reach the green.

H. D. G. (Bristol).—Your letter is far too long and complicated to be dealt with in detail. To sum up our advice in a few words: by changing your aerial from Fig. 1 to Fig. 3, you increase its average height from 31 ft. to 41 ft., and would, therefore, get much better signals, although, since you are changing from 5 wires to 2, you will require more inductance to tune up to the same waves. Your connections are all right except for the fact that in both figures you show the battery and potentiometer (which very likely are poorly insulated, and in any case have a considerable capacity to earth) connected to the high-potential end of a circuit—in Fig. 1 to the top of the long tuning-inductance, and in Fig. 2 to the top end of the jigger-secondary. If you read our columns carefully, you will see that the crystal should go *direct* to the high-potential end of the circuit, and things which are earthed, partially earthed, or have a big capacity to earth, should be connected to the low-potential end; that is, in Fig. 1, to the earthed end of the tuning-inductance, and in Fig. 2 to the bottom end of the secondary, which should be coupled to the earthed primary *only at the bottom end.*

G. E. H. (Aberdeen).—With your two-wire 70-yard aerial, your tuning-coil of No. 20 wire, 4 in diameter, and 10 in. long, is probably quite insufficient for the waves you wish to receive, and you had better increase it to about 4,000 microhenries. You will find a formula in the *Year Book of Wireless Telegraphy and Telephony* for calculating this inductance, or perhaps you already know one. The ultimate end of the pipe which runs down the house, and which is forming your earth, is wrapped in mystery; it is quite possible that it forms a very ineffective earth, but, on the other hand, if it continues of metal and runs well underground, and has no joints with any insulating material in them, then it might be quite good, especially if it delivers water and thus keeps the ground around it wet.

E. T. F. (Pretoria).—The probable effect of running your aerial for all its length 5 feet above a corrugated iron roof will be to give you an aerial whose effective height is about 5 ft. On the other hand, some strange results have been recorded where the near neighbourhood of earthed conductors has worked miracles in the way of improving signals. Frankly, we do not feel very much confidence in these results, but it is not safe to lay down the law in wireless. We do not think that the dynamo within the iron building would trouble you.

N. de P. ("Marci").—(1) In the *Year Book of Wireless Telegraphy and Telephony* on page 331 it states that "The condensers are protected against excessive increase of voltage from surging, by suitable spark gaps placed at various positions on the bus-bars." Is this a misprint or is it an addition to the ordinary Marconi set? (2) Can you tell me an effective means of reducing the self-induction in the telephones when the converter is running? (3) Whilst operating recently I had occasion to pull out wall plug from receiving to send, and got a very severe shock from the plug.

Answer.—(1) Neither a misprint nor an addition. In certain sets—notably the smaller ones—the maximum voltage which can be produced by local surging is well below the breakdown voltage of the condenser, provided the set is worked properly. Hence there is no "excessive increase," and, therefore, there are no spark-gaps on the bus-bars; the only safeguard provided being the safety-gap across the discharger, which protects the set in case too long a spark is used. In the larger sets the bus-bar gaps are provided if, owing to the length of bus-bars, the large capacity of the condenser, and other reasons, excessive local surges are liable to occur. (2) Keep your commutator in good order so as to avoid sparking; earth the lead covering of the a.c. wiring; open your a.c. switch. (3) We can only suggest that it was some kind of retribution.

A. H. has obtained carborundum from several different sources, but has been unable to find a crystal which would approach zincite-pyrites or zincite-bornite for sensitiveness and general efficiency on a *small* aerial. Even silicon, he says, is very much better. He does not transmit, and suggests that, perhaps, this would account for the discrepancy between his experience and our recommendations, as he can quite understand that these extremely sensitive crystals might not stand so well if subjected to comparatively heavy voltages. We were getting nervous, and started wondering whether we should jump at this excuse, while surreptitiously getting rid of our stock of carborundum, when we were relieved to notice his post-scriptum: "I get Cleethorpes, Norddeich and Poldhu, etc., sometimes very loudly with zincite, but with carborundum sometimes can hardly get Eiffel. . . ." His aerial is 300 ft. long and 40 ft. high; and if he can sometimes "hardly get F. L." with carborundum, something must be seriously wrong; something which cannot be attributed to the inferior sensitiveness of carborundum as a receiver. A. H. should read (1) Our comment on Mr Pope's letter; (2) Our answer to W. V. H.; (3) Our answer to "Zeta," and (4) Our answer to W. E. D., all in the February number. If possible, he should get hold of a micro-ammeter (or adapt a milli-voltmeter so as to use it as a micro-ammeter) and set to work to plot the curves of a few of his carborundum specimens; the results should help him to make sure that he is applying the potential in the right direction and to the right amount.

R. B. (London).—(1) What would be a suitable design for a transformer to take 50 watts from 205 volts a.c. mains 50 ciphers? (2) My aerial is T-shaped. Could receiving results be improved by altering design of my aerial?

Answer.—(1) Buy one ready-made; it will be cheaper. Specify your requirements as to voltage, frequency, and power. (2) You certainly should not work with the arms of your T unequal, though, as a matter of fact, your aerial is so short compared with the long waves you are probably receiving that the inequality will not matter so much as it would in the case of an aerial designed for those waves. But it must be bad for your short-wave transmission. For the latter, it would be best for you to transfer your down-lead to the centre of the horizontal part, if converting the whole into an inverted L aerial by a down-lead from the far end (the house seems to get in the way of a down-lead from the near end) produces a natural wave-length too great for your transmitting licence. This latter plan would appear to be the best of all for long-wave reception, but it would give you a natural wave of over 200 metres. As a compromise, we should be inclined to transfer the down-lead to the centre of the horizontal part.

R. B. (Queenstown).—The station at Poldhu was originally erected for Trans-Atlantic work, but this class of work is now being performed through the Clifton Station, and Poldhu will work a continuous commercial service with Spain.

With regard to your second inquiry we would refer you to our April, 1913, number for details of the *Pembroke* to *H.M.S. New Zealand* feat. We might suggest the advisability of keeping a file of the back numbers of THE WIRELESS WORLD.

F

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Patent Record.

1914.

1,169. January 15th. Wm. H. Shephard and A. E. McKechnie. Wireless telegraph or telephone system.

1,556. January 20th. John Hays Hammond, Junr. Control of moving bodies by radiant energy.

2,206. January 27th. Fernand Holweck. Cathodic detectors.

2,214. January 27th. Robert Goldschmidt. Spark gap devices for wireless telegraphy.

2,413. January 29th. Wm. H. Shephard and A. E. McKechnie. Recording apparatus for use with line or wireless telegraph systems.

2,679. February 2nd. John Hays Hammond, Junr. Methods of controlling distant apparatus by Hertzian waves.

2,738. February 2nd. Roberto C. Galletti. Transmission of wireless signals.

2,739. February 2nd. R. C. Galletti and Richardo Manzetti. Electric dischargers.

2,740. February 2nd. Roberto C. Galletti. Method of producing electric impulsive discharges.

2,935. February 4th. Auguste L. Chaudet. Crystal detectors for wireless telegraphy.

3,080. February 5th. A. T. M. Johnson, F. H. Varley and Annie C. N. Try. Wireless telegraphy.

3,171. February 6th. Egbert von Lepel. Method of periodically modifying high-frequency electric currents.

3,191. February 6th. George O. Squier. Radio-telegraphic and radio-telephonic receiving system.

3,192. February 6th. Emile Girardeau. Radio-telegraphic station.

3,232. February 7th. W. P. Thompson (for Rudolf Goldschmidt, Germany). Frequency transformers.

Obituary.

It is with regret that we record the death of Mr. Ernest Thomson, wireless operator on the ss. *Michigan*. Mr. Thomson joined the Marconi Company in the June of last year, and on January 1st was appointed to the *Michigan*. On January 6th, however, he was taken to the hospital at Antwerp, suffering from typhoid fever, to which he succumbed two days later. It is sad that death should have cut short what promised to be a very successful career, for Mr. Thomson was full of initiative and energy, and took an active interest in his work. He was in his twentieth year.

Marconi House Notes

Debating Society.

The Debating Society has held two meetings during the month. The subject of the first debate, "Is the granting of adult suffrage desirable in the best interests of the community?" gave an opportunity for Mr. Sampson to open eloquently the case for the affirmative position. Mr. Bangay replied from the opposite point of view, and when, after a long debate, Mr. Rattray, the chairman, took the voting, the general opinion was shown to be in favour of wider franchise.

The second meeting debated "Is the future of the country bound up in Trade Unionism?" The debate was opened by Mr. Rice, the secretary, to whom replied Mr. Morse. Mr. Stevenson made an interesting suggestion for the accommodation of Trade Unions to the needs of the future. Captain Sankey, in the chair, did much to encourage the timid and stimulate the discussion when it showed signs of getting thin. The voting was with practical unanimity in favour of the prospects of Trade Unionism.

Football Section.

The return match with Oratory Brigade will be played on March 7th, at South Ealing, and if the Marconi team play well enough to reverse their former defeat, they may once more take top place in the competition.

Tennis Section.

Last month the Lawn-Tennis Section held a general meeting for the purpose of electing officers for the coming season. The result of the voting was that Miss Haynes and Messrs. Pontifex and Cummins were re-elected. The Committee by their own labours, and with the assistance of two energetic volunteers, brought in by the appeal made in this column last month, have already made an excellent start on the re-turfing of the courts. Doubtless the weather has prevented many of the members of this large section of the club from lending a hand, but we would remind these that the task is not yet completed, so that the opportunity of co-operation is still theirs to take.

The Musical Society.

All the efforts of the Musical Society were at the time of writing directed to preparations for the concert, which took place on February 21st. It was found necessary to enlarge the stage in order to accommodate the massed bands, which numbered some 40 players. The chief feature was the contest between the Works (Chelmsford) and Office (London) Bands for a handsome cup presented by the Directors of the Marconi Company.

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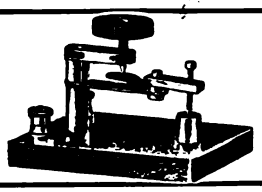

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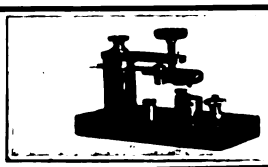

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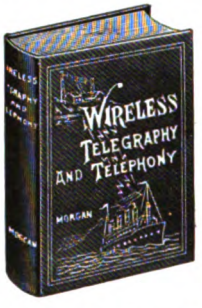

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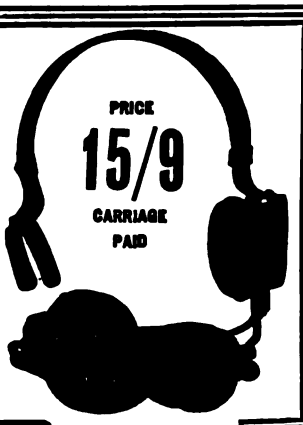

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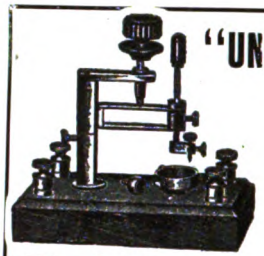

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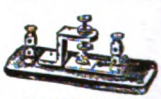

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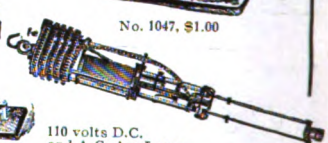

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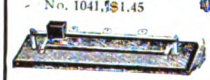

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Secondary Cell Maintenance by J. G. LUCAS.
New Cables: The Anglo-German Telegraph and the Anglo-Irish Loaded Telephone Cables.
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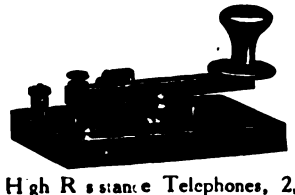

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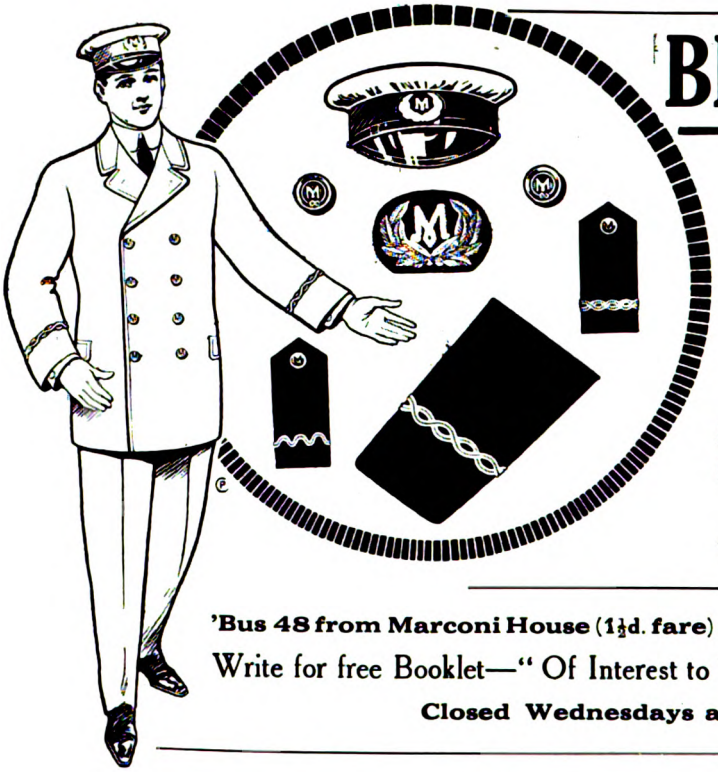

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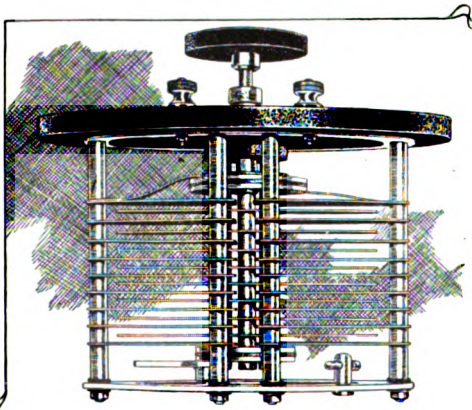

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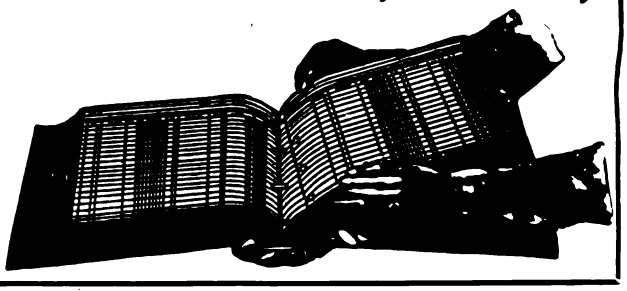

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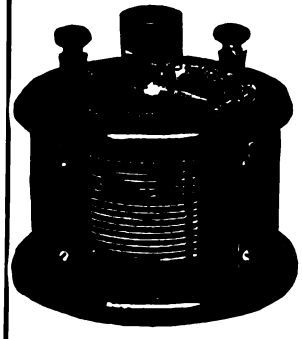

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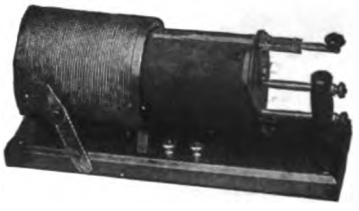

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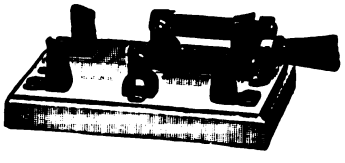

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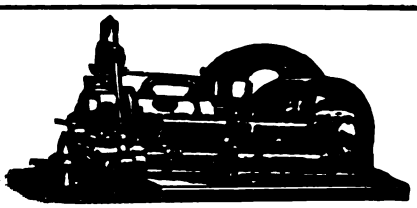

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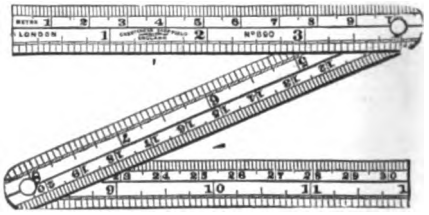

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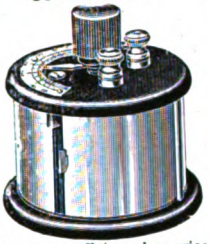

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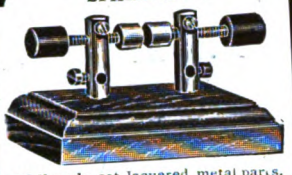

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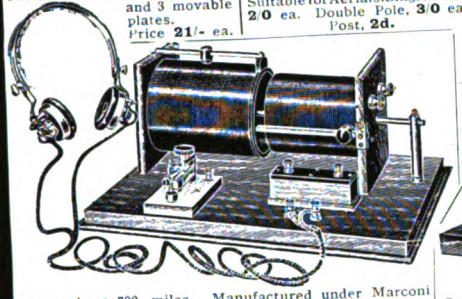

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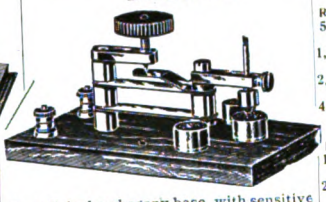

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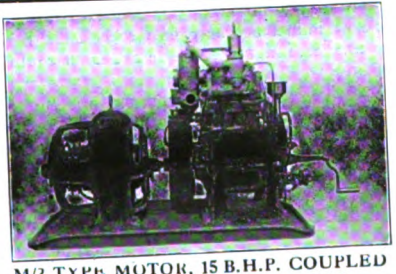

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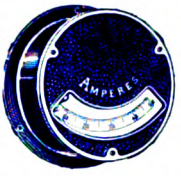

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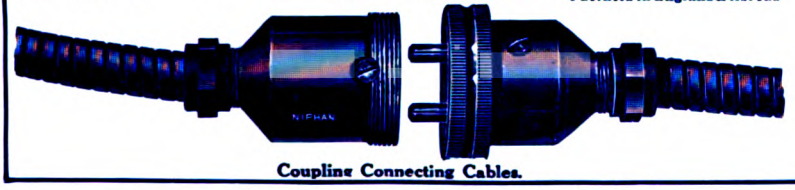

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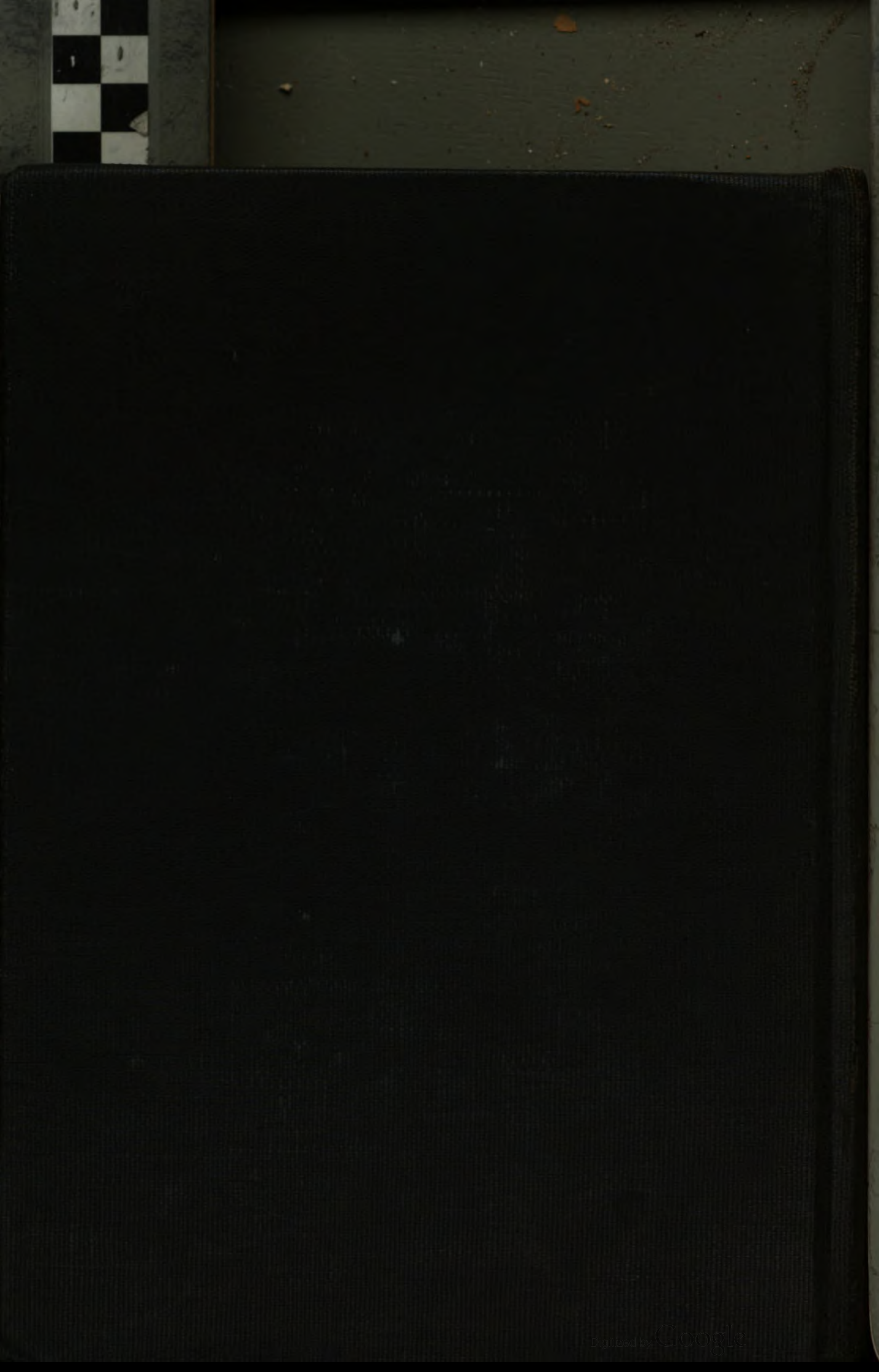
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